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Contract contingency in vertically related markets*

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Abstract

Over the last years, courts are increasingly inclined to consider pre-contractual arrangements as binding contracts, endowing them with commitment value that can be used strategically by the party that proposes them. We study the optimal pre-contractual arrangement offers of an upstream monopolist producing an essential input that may sell to two vertically differentiated downstream firms. These arrangements concern the exclusivity and the contingency of the contracts to be signed. Once the pre-contractual arrangements have been determined, the terms of the contracts are negotiated between the upstream supplier and the downstream firm(s). The distribution of bargaining power during the contract terms negotiations is the main driving force of the monopolist's choices. A powerful supplier always opts for an exclusive contract. By contrast, a weaker supplier offers non-exclusive contracts and makes each of them contingent or non-contingent such as to guarantee the most favorable outside option in its negotiations.

Keywords: Vertical relationships, exclusive vs. non-exclusive relationships, contract contingency, two-part tariff, product differentiation, pre-contractual arrangement.

JEL classification: D43, L13, L14.

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1 Introduction

Along production chains, the trading relationships among firms are governed by contracts that can take a variety of forms.[1] Vertical contracting is thus crucial for determining the behavior and performance of firms in the production chain as well as for the whole industry they operate in. Vertical contracting refers not only to the type of contracts used in the trading between upstream and downstream firms, but also to the process via which the specific contractual terms are determined. Although the complete contractual terms that will be executed in case of successful negotiations must be included in the final contract, it is common to observe that these final contracts originate from pre-contractual arrangements. These arrangements frame the ensuing negotiations which, in turn, determine the final contractual terms. In the legal jargon, such arrangements are often referred to as "letters of intent", "memorandums of understanding" or "term sheets" and, historically, were not considered as binding by the courts.[2] This entailed that no party could be held liable for breaching an agreement that was not contained in a formal, complete contract. Yet, quoting Farnsworth (1987, p.222):

"In recent decades, courts have shown increasing willingness to impose precontractual liability."

The characteristics that make pre-contractual arrangements enforceable and what actual obligations they entail depend on each judicial system. Traditionally, though a debate exists, US and continental Europe courts are more prone than English ones to confer any liability based on preliminary agreements. However, in the recent years, in most countries the stance is rapidly evolving toward the idea that a preliminary agreement *at least* engages the parties to continue the negotiations *in good faith* over the open terms, to eventually sign a final contract, see, e.g. Draetta and Lake (1993); Ben-Shahar (2004); Schwartz and Scott (2007);

[1] For empirical studies regarding the contract types that may be signed among trading partners see e.g., Villas-Boas (2007); Inderst and Mazzarotto (2008); Thanassoulis and Smith (2009) and Bonnet and Dubois (2010).

[2] A similar concept is that of Umbrella Agreements, which, though" [...] not concerned with immediate contractual decisions [...][,] provide an explicit framework of norms within which contractual decisions can be made", Mouzas and Ford (2006, p.1249).

Cartwright and Hesselink (2008); Trakman and Sharma (2014) and the references therein.[3] It is important to remark that the duty to negotiate in good faith does not impose to the parties to reach a deal at any cost, rather to do their best efforts to reach a final agreement within the frame of the preliminary agreement. This paradigmatic shift has important consequences as pre-contractual arrangements can no longer be considered as "cheap talk" but are now endowed with commitment value and can be used strategically by the party that proposes them.

In this paper we investigate the optimal pre-contractual arrangement offers of an upstream monopolist selling an essential input to downstream firms which produce vertically differentiated final goods. These offers concern some features of the contracts to be signed, and in particular, their exclusivity and their contingency. Once the contracts have been selected, their terms are negotiated between the upstream supplier and the downstream firm(s). Assuming that contracts take the form of two-part tariffs, we inquire into the following issues. Does the upstream supplier have incentives to foreclose one of the downstream firms by offering an exclusive contract to the other firm? And if so, the foreclosed firm will be the high- or the low-quality one? When the upstream firm offers non-exclusive contracts to both downstream firms, what will be the specific type of these contracts? Under what conditions will it offer a contingent contract that allows renegotiation of contract terms with one downstream firm in case of breakdown in the negotiations with the other one?[4] Or when will it offer a non-contingent contract not allowing for such renegotiations? What are the market and societal implications of the upstream monopolist's contract configuration selection?

We consider a vertically related industry with an upstream monopolist and (potentially) two downstream firms. The upstream supplier produces an essential input that sells to one or both downstream firms, depending on its decision at the outset of the game to offer an exclusive or two non-exclusive contracts, respectively. The downstream firms are endowed with different technologies that allow the production of different output qualities using the

[3] Appendix 1 briefly presents some cases that have been a watershed in jurisprudence.

[4] According to (Bazerman and Gillespie, 1998, p. 155), "the terms of a contingent contract are not finalized until the uncertain event in question–the contingency–takes place."

same input (see Gabszewicz and Thisse, 1979; Shaked and Sutton, 1983).[5] If the upstream supplier chooses to offer contracts to both downstream firms, it must also decide whether each of them is contingent or non-contingent. A contingent contract is more flexible and allows negotiating parties to set different contractual terms in case of agreement and in case of disagreement in the rival bargaining pair. This flexibility is absent under a non-contingent contract.

We study a three-stage game with observable actions. In the first stage, the upstream monopolist decides to offer an exclusive contract or two non-exclusive ones. This is a pre-contractual arrangement that, in legal terms, can be materialized by using a letter of intent wherewith the upstream firm sets out its intentions about the number and type of contractual relations to enter.[6] If the monopolist opts for an exclusive relation, it also decides to which of the downstream firms to make the offer.[7] In the case of non-exclusivity, it also decides the configuration of contracts to be offered, i.e., two contingent, two non-contingent, or mixed (one contingent and another non-contingent) contracts.[8] In the second stage, negotiations over contract terms take place between the upstream monopolist and the downstream firm(s). In case of non-exclusive contracts, these negotiations take place simultaneously and separately between the upstream supplier and each of the downstream firms. In the last stage, under non-exclusive contracts, the downstream firms compete in the market by selecting their prices; under an exclusive contract, the downstream monopolist sets its price.

As the alternative types of non-exclusive contracts are central in our analysis, a discussion in detail of their features will be of great help for the sequel. A non-exclusive contract signed between the upstream supplier and a downstream firm can be of two types: *contingent* and *non-contingent*. A contingent contract contains specific terms in the event of a breakdown in the negotiations in the *rival* bargaining pair. An immediate consequence is that the outside

[5] For instance, one of the downstream firms has a proprietary technology that allows it to increase at no cost the quality of its good.

[6] Appendix 2 describes more in detail the *letter of intent*.

[7] Exclusive negotiation provisions often characterize pre-contractual agreements, see, e.g. Draetta and Lake (1993); Mouzas and Furmston (2008).

[8] Appendix 3 presents evidence supporting the fact that pre-contractual arrangements may contain contingent clauses.

options for the negotiating firms fully internalize the implications of the negotiation failure in the rival pair. By contrast, a non-contingent contract does not allow for renegotiation of contract terms in case of a breakdown in the negotiations in the *rival* bargaining pair. As a consequence, the outside options for the negotiating firms are determined by their equilibrium contractual terms. Therefore, the crucial difference between the two types of non-exclusive contracts lies on the outside options that are attributed to negotiating parties under each of them (see e.g., Milliou and Petrakis, 2007).[9]

Our analysis highlights the role of the bargaining power distribution between the upstream supplier and each of the downstream firms for the optimal selection of contracts. In particular, when the upstream supplier is quite powerful, it offers an exclusive contract to the high quality downstream firm, whereas it selects two non-exclusive contracts when its bargaining power is not too high. The upstream supplier faces the following trade-off when selecting between an exclusive and two non-exclusive contracts. Under an exclusive contract, competition downstream is absent altogether, therefore, under two-part tariff contracts, the vertically integrated structure's outcome is obtained. Yet, the upstream supplier's outside option (i.e., its profits when the negotiations with the downstream firm break down) is nil in this case. This entails that its share of the vertically integrated entity's profits is proportional to the upstream bargaining power. The lower the latter, the smaller the profit that the upstream supplier is able to extract. By contrast, with non-exclusive contracts that are negotiated simultaneously and separately, competition downstream erodes part of the aggregate producer surplus (O'Brien and Shaffer, 1992). Yet, with non-exclusive contracts, the upstream supplier may have a stronger *bargaining position*, i.e., it may enjoy positive outside options in its negotiations with the downstream firms for any level of its bargaining power. A powerful upstream firm can extract most of the vertically integrated structure's profit and prefers, thus, to avoid creating downstream competition that reduces the aggregate producers surplus. In addition, as the production of the high-quality good generates a higher surplus, the upstream opts to

[9] In an empirical analysis of financial contracts, Roberts and Sufi (2009, p.167) find that "[...] contingencies shape the outcome of renegotiations by altering the default option and relative bargaining power in a manner to preserve ex ante incentives.".

offer the contract to the high quality downstream firm. In this way, the upstream supplier forecloses the low-quality firm.

As the upstream supplier becomes less powerful, it can extract a lower share of the vertically integrated structure. Nonetheless, by offering two non-exclusive contracts, the upstream supplier can enjoy a stronger bargaining position through the creation of outside options in its negotiations with the downstream firms (of course, this comes at the cost of reducing the aggregate producer surplus due to downstream competition). In particular, for "intermediate" levels of bargaining power, the upstream firm opts for two non-exclusive, contingent contracts, whereas for even lower values of it, it offers a non-contingent contract to the high-quality downstream firm and a contingent contract to the low-quality one. Finally, an upstream supplier with quite low bargaining power opts for two non-exclusive, non-contingent contracts. As discussed above, a contingent contract is more flexible in the sense that it allows a negotiating pair to specify different contract terms in case of agreement and in case of disagreement in the rival bargaining pair. This translates into higher outside options for the upstream supplier under contingent than under non-contingent contracts, but only if its bargaining power is not too low. The opposite holds for lower values of the upstream bargaining power, in which case the upstream supplier opts for one or two non-contingent contracts. In the mixed contract configuration, the non-contingent contract is always offered to the high-quality firm. In this way, the upstream supplier enjoys the largest outside options once again.

In addition, our analysis reveals that the degree of vertical product differentiation affects the upstream supplier's choice of the configuration of non-exclusive contracts. In particular, as the goods become less differentiated, the range of parameters for which the upstream supplier offers mixed contracts shrinks; moreover, that non-contingent contracts are more often selected when the product differentiation takes intermediate values.

Interestingly, the fixed fees of the equilibrium non-exclusive contracts are sometimes negative, i.e., the upstream supplier pays "slotting allowances" (Shaffer, 1991; Marx and Shaffer, 2010) to one or both downstream firms. This is always true when the upstream supplier offers two non-contingent contracts. It is also true under contingent and mixed contracts as long as

the upstream bargaining power is low enough. Surprisingly, under some circumstances, the contract offered to the low-quality firm generates an overall loss for the upstream supplier. This loss is however covered by a substantial gain for the upstream supplier that so enjoys a stronger bargaining position vis-à-vis the high-quality downstream firm.

Our paper connects to several strands of the literature. First, it contributes to the literature on vertical contracting. A main theme within this literature is the commitment problem that arises for an upstream monopolist when it trades with multiple competing downstream firms (see, e.g. Horn and Wolinsky, 1988; O'Brien and Shaffer, 1992; McAfee and Schwartz, 1994, 1995; Rey and Vergé, 2004). These papers, however, do not consider the optimal choice of contracts offered by the upstream supplier to the downstream firms. Our paper undertakes this task and highlights the differential impact of contingent and non-contingent, non-exclusive contracts on the severity of the upstream monopolist's commitment problem. Based on that, we are able to identify conditions under which an upstream monopolist offers an exclusive or two non-exclusive contracts, and within the non-exclusive contracts when it offers contingent, non-contingent and mixed contracts to the downstream firms.

We also contribute to the literature on the effects of countervailing buyer power (see, e.g. Inderst and Wey, 2003, 2007 and Chambolle and Villas-Boas, 2015) by focusing on the effects of pre-contractual arrangements and contract contingency on the bargaining position of the negotiating parties.[10] Milliou and Petrakis (2007) delve into the merger incentives of upstream firms when they choose the optimal contracts (liner or non-linear) to offer to the downstream firms.[11] By contrast, we highlight that the contingency or non-contingency of the contract terms is crucial for the selection of contracts by the upstream monopolist. Further, Miklós-Thal *et al.* (2011) consider powerful downstream retailers offering take-it-or-leave-it contracts to an upstream supplier that may be contingent on an exclusive relationship, and show that contingency may lead to the replication of monopoly outcomes. From a comple-

[10] From a broader perspective, our viewpoint of contract contingency as an instrument to affect the bargaining position of the negotiating parties is alternative to those suggested in the economic literature, in which contract contingency is seen as a tool to reduce the incompleteness of contracts (see, e.g. Hart and Holmström, 1987), and in the management literature, in which it is seen as a tool to share risks (Byialogorsky and Gerstner, 2004)

[11] Their analysis is cast in the framework of non-contingent contracts. Yet, they also deal with contingent ones, without though endogenizing the choice between these two types of contracts.

mentary standpoint, Iozzi and Valletti (2014) delve into the impact of the (un-)observability of breakdown in negotiations on the outside option of an upstream supplier bargaining with multiple horizontally differentiated downstream retailers. The authors consider contracts that are linear and non-contingent and focus on how the observability of breakdowns influences the contractual terms and the upstream firms' incentives to merge. Moreover, they do not consider the upstream monopolist's incentives to reveal information over a breakdown - the observability or not of breakdowns in negotiations is taken as given. In contrast, we focus on the contingency or not of interim observable non-linear contracts that are optimally chosen by an upstream monopolist.

Our paper also contributes to the literature on vertical foreclosure. Hart and Tirole (1990), O'Brien and Shaffer (1992), and McAfee and Schwartz (1994) show that under secret contracting, exclusive agreements or vertical integration can help a dominant supplier to reestablish its market power. Rey and Tirole (2007) provide an excellent overview on vertical foreclosure and stress the anticompetitive motives for upstream firms to use exclusive agreements and vertical mergers in order to foreclose downstream firms. The received literature, however, does not consider vertically differentiated industries. In line with this literature, we show that an upstream monopolist opts for an exclusive contract with the high-quality downstream firm, thus foreclosing the low-quality one, in order to restore its market power. Nevertheless, this is optimal for the supplier only when its bargaining power is sufficiently high. Otherwise, the upstream supplier has incentive to keep both competing downstream firms in the market.[12]

The remainder of the paper is organized as follows. Section 2 presents the model, Section 3 explores the various contractual choices and Section 4 performs the contractual choice equilibrium analysis. Section 5 discusses the equilibrium outcomes. Finally, Section 6 provides concluding remarks.

[12] In a quite different setup Matsushima and Shinohara (2014) show that a supplier has incentives to enter non-exclusive relationships when its bargaining power is low. The main driving force of their result is that the supplier incurs high sunk investment costs to produce the essential input for each downstream firm.

2 The model

2.1 Firms and market structure

Consider an upstream monopolist, denoted by $\mathcal{U}$, producing at no cost an essential input that may sell to two downstream firms. Downstream firms use this input to produce, on a one-to-one basis, a final good. Besides the input costs, downstream firms incur no additional production costs. One of these firms has a proprietary technology that allows it to increase at no cost the quality of its good. Denote the latter "high-quality good" and the downstream producer "high-quality firm", $\mathcal{D}_h$. The other downstream firm, the "low-quality firm", $\mathcal{D}_l$, does not dispose such a technology and thus produces the "basic" version of the good, i.e., the "low-quality good".

The upstream monopolist is entitled to propose the pre-contractual arrangements, i.e., a set of restrictions that frame the ensuing negotiations with the downstream firms. If the pre-contractual arrangement proposed to a downstream firm includes an exclusivity clause, this commits the monopolist to negotiate only with that firm in the following stages of the game. In this case, the downstream market is a monopoly. By contrast, if the upstream supplier chooses to sign non-exclusive contracts, it trades with both downstream firms and thus the downstream market is a vertically differentiated duopoly. In this case, the choice of the pre-contractual arrangement concerns the contingency or not of the contracts. Contingent contracts allow bargaining partners $\mathcal{U}$ and $\mathcal{D}_i$ to execute different terms in case of agreement, or disagreement, between $\mathcal{U}$ and $\mathcal{D}_j$. Under non-contingent contracts, the bargaining partners should stick to their negotiated equilibrium contract terms under all contingencies. The upstream supplier decides which type of non-exclusive contract to offer to each downstream firm.[13]

Vertical contracts are non-linear and in particular, take the form of two-part tariffs, and are bargained upon between the upstream monopolist and the downstream firm(s). During

[13]The pre-contractual arrangement may be materialized by a letter of intent which contains the number and - in case of non exclusivity - the type of contractual relationships which the upstream supplier is willing to enter. Contracts may then be made contingent by including in such letters the appropriate conditions precedent.

the contract negotiations, the bargaining power of $\mathcal{U}$ and $\mathcal{D}_i$, $i = h, l$, are μ and $1 - \mu$, $0 \leq \mu \leq 1$, respectively. We admit that assuming equal bargaining power for downstream firms possessing different technologies is made for analytical convenience.[14] Yet our main findings remain qualitatively similar if we assume that the high quality downstream firm has a relatively higher bargaining power, provided that the power differential is not too large.

2.2 Demand

A continuum of heterogeneous consumers of unit mass is uniformly distributed with unitary density over the interval $[0, 1]$. A consumer θ, $\theta \in [0, 1]$, is characterized by the indirect utility function

$$U(\theta, u_i) = \begin{cases} \theta u_i - p_i & \text{when buying one unit of good } i, \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

where u_i is the (given) quality level of good i and p_i is its price. Remember that u_i only depends upon the downstream firm selling the good.

Under an exclusive contract, there is only one good available in the market. Using the standard marginal consumer approach, its demand is

$$D_m(p_m) = 1 - \frac{p_m}{u_i}, \tag{2}$$

where the subscript m indicates "downstream monopoly" and $i = h, l$, depending on which downstream firm the supply contract has been signed with. In this case, the consumer surplus is

$$CS_m(p_m) = \int_{\frac{p_m}{u_i}}^{1} (\theta u_i - p_m) d\theta. \tag{3}$$

Under non-exclusive contracts, two goods are available in the market. Using again the stan-

[14] Note that the existing literature does not offer a legitimate, widely acceptable method of modeling bargaining power asymmetries among heterogeneous firms.

dard marginal consumer approach,[15] their demands are

$$D_h(p_h, p_l) = 1 - \frac{p_h - p_l}{u_h - u_l}, \quad D_l(p_h, p_l) = \frac{p_h - p_l}{u_h - u_l} - \frac{p_l}{u_l}, \tag{4}$$

with $u_h > u_l > 0$ being the quality levels of the two goods. The consumers surplus is

$$CS(p_h, p_l) \equiv \int_{\frac{p_l}{u_l}}^{\frac{p_h - p_l}{u_h - u_l}} (\theta u_l - p_l) d\theta + \int_{\frac{p_h - p_l}{u_h - u_l}}^{1} (\theta u_h - p_h) d\theta. \tag{5}$$

2.3 Timing

We consider a three-stage game with observable actions. At the first stage, the upstream supplier decides whether to offer an exclusive contract, and if so, to which of the downstream firms. If, instead, it decides to offer non-exclusive contracts, the upstream supplier selects also whether to make each of these contracts contingent or non-contingent. At the second stage, the upstream monopolist and the downstream firm(s) bargain (simultaneously) over two-part tariff contract(s).[16] Finally, the downstream firm(s) set price(s) in the market.[17]

As is standard (see e.g. Milliou and Petrakis, 2007), we use subgame perfection to solve our three-stage game. Moreover, we invoke the Nash equilibrium of simultaneous generalized Nash bargaining problems to solve for the simultaneous contract terms negotiations between $\mathcal{U}$ and each of $\mathcal{D}_i, i = h, l$, under non-exclusive contracts. Under exclusive contracts, the generalized Nash bargaining solution is also used to solve for the contract terms negotiations between $\mathcal{U}$ and one of the downstream firms.

[15] The consumer which is indifferent between buying the high or the low quality good is determined by $\theta_{hl} u_h - p_h = \theta_{hl} u_l - p_l$; and the consumer which is indifferent between buying the low quality good or not buying at all is determined by $\theta_{l0} u_l - p_l = 0$.

[16] This is in line with a branch of the literature analyzing contractual relationships in which one party unilaterally proposes some of the trading terms, while the others are negotiated upon, see, e.g. Dukes and Gal-Or (2003); de Meza and Selvaggi (2007) and Matouschek and Ramezzana (2007).

[17] Section 6 briefly discusses the alternative case in which firms compete in quantities.

3 Contract terms and market outcomes

In the next subsections, we analyze the subgames in which the upstream monopolist offers respectively an exclusive contract or two non-exclusive contracts. In the latter case, we distinguish between the symmetric cases in which both downstream firms are offered either non-contingent or contingent contracts and the mixed cases of one downstream firm being offered a contingent and the other a non-contingent contract.

3.1 Exclusive contract

Under an exclusive contract, the downstream firm to which the upstream supplier offers the contract becomes a monopolist in the final good market. Let $T_m \equiv (w_m, t_m)$ be the two-part tariff contract signed by the upstream and the downstream firm, where w_m is the input price and t_m is the fixed fee, with m standing for downstream *monopoly*. The profits of the upstream and downstream firms are, respectively

$$\Pi_m(p_m, T_m) = D_m(p_m)w_m + t_m, \quad \pi_m(p_m, T_m) = D_m(p_m)(p_m - w_m) - t_m. \tag{6}$$

In the last stage, the downstream firm maximizes its profit by setting $\hat{p}_m(w_m) = \frac{u_i + w_m}{2}$. Substituting the latter into (6), we obtain downstream and upstream equilibrium profits

$$\hat{\Pi}_m(T_m) = \frac{(u_i - w_m)w_m}{2u_i} + t_m \tag{7}$$

and

$$\hat{\pi}_m(T_m) = \frac{(u_i - w_m)^2}{4u_i} - t_m. \tag{8}$$

Turning to the second stage, the upstream supplier and the downstream firm negotiate over the contract terms. As the upstream supplier is committed to offer an exclusive contract, in case of failure to reach an agreement neither the upstream nor the downstream firm operate in the market; hence both firms' outside options are nil.[18] The generalized Nash product is,

[18] This is a common assumption in the literature, see, e.g. Dukes and Gal-Or (2003) and de Meza and

therefore,

$$NP_m(T_m) = \hat{\Pi}_m(T_m)^{\mu}\hat{\pi}_m(T_m)^{1-\mu}. \tag{9}$$

The maximization of (9) with respect to w_m and t_m yields $w_m^* = 0$ and $t_m^* = \frac{u_i}{4}\mu$. As standard in this case, the two-part tariff contract is set in such a way as to maximize the joint profit of the vertical chain. This is achieved by setting the input price equal to the upstream marginal cost and by apportioning the maximum joint profit between the upstream and downstream firm via the fixed fee, according to their respective bargaining powers. Therefore, the profits accruing to the upstream firm are $\frac{u_i}{4}\mu$ and are increasing in the quality of the good u_i. As a consequence, the upstream supplier will offer the exclusive contract to the high quality downstream firm. The following Lemma summarizes our findings.

Lemma 1. *If the upstream supplier opts for an exclusive contract, it offers it to the high quality downstream firm. The equilibrium contract terms are* $w_m^* = 0$ *and* $t_m^* = \frac{u_h}{4}\mu$. *The equilibrium price is* $p_m^* = \frac{u_h}{2}$,*the equilibrium demand is* $D_m^* = \frac{1}{2}$, *and the equilibrium profits of the upstream and downstream firms are, respectively,* $\Pi_m^* = \frac{u_h}{4}\mu$ *and* $\pi_m^* = \frac{u_h}{4}(1-\mu)$. *Moreover, the consumer surplus is* $CS_m^* = \frac{u_h}{8}$.

3.2 Non-exclusive non-contingent contracts

We now turn to the case in which the upstream monopolist offers supply contracts to both downstream firms. For the sake of brevity, we will often refer to the contract signed between the upstream supplier and the high (low) quality downstream firm as "the high (low) quality contract". We assume that negotiations over contract terms within each $(\mathcal{U}, \mathcal{D}_i)$ pair occur simultaneously and separately, and that the contracts are *interim observable*, i.e., once the contracts have been signed, their terms become known to all the parties (see e.g., McAfee and Schwartz, 1995). It is well-known that in such a situation, the vertical relations between the upstream supplier and each of the downstream firms are affected by opportunism. In particular, within each $(\mathcal{U}, \mathcal{D}_i)$ negotiating pair, an incentive exists to secretly renegotiate

Selvaggi (2007).

the contract terms at their own advantage and at the expense of the rival downstream firm j $(i, j = h, l, i \neq j)$. One of the consequences is that multiple equilibria may arise in this case. To deal with this issue and obtain a unique outcome, we invoke *pairwise proofness* in the equilibrium contracts (O'Brien and Shaffer, 1992; Milliou and Petrakis, 2007; Alipranti *et al.*, 2014). A known issue regarding multiple agency models with passive beliefs is that a Perfect Bayesian Equilibrium (PBE) sometimes fails to exist. As pointed out by Rey and Vergé (2004), this is due to the existence of profitable multilateral deviations by the upstream firm $\mathcal{U}$ when making take-it-or-leave-it offers to the downstream firms. This notwithstanding, a number of reasons leads us to adopt such an equilibrium concept. First, it allows for analytical tractability, which is not always the case when one considers other off–equilibrium belief structures, such as, e.g., wary beliefs. Second, our negotiation protocol builds on the Nash bargaining solution. In the usual narrative, under this type of bargaining the parties, once agreed on the properties of the sharing outcome –the "axioms"– can only apportion the joint surplus following the Nash Bargaining procedure, as multi- and unilateral deviations in this cooperative framework are not contemplated. From this standpoint, our approach is consistent with the "bargaining equilibrium" for multilateral vertical contracting introduced by Rey and Vergé (2017). At the contract negotiation stage, the bargaining equilibrium is defined as a vector of (non-linear) tariffs, each of which (i) maximizes the joint bilateral profit of the relevant upstream and downstream pair of firms, given the other tariffs and the induced retail prices, and (ii) assigns a given share of the maximized bilateral surplus to each firm. This equilibrium concept "discards the possibility of multi-sided deviations" (Rey and Vergé, 2017, p.7).[19] Third, even if we visualize the Nash bargaining solution as the (limit) equilibrium of a sequential offers-counteroffers bargaining game (see e.g. Binmore *et al.*, 1986), in which $\mathcal{U}$ makes simultaneous, secret take-it-or-leave-it two-part tariff offers to the downstream firms,

[19] In our bargaining setup with two part tariffs, the Nash bargaining solution can be found in two steps. First, negotiating parties choose marginal transfer prices to maximize the surplus to be divided. Second, they negotiate fixed fees to transfer surplus. (O'Brien and Shaffer, 1992, p.305). Clearly, this is consistent with the "multi-sided deviation-free" bargaining equilibrium by Rey and Vergé (2017). Note that the analysis by Rey and Vergé (2017) is developed under the assumption of secret contracts, whereas in the present paper contracts are interim observable. Yet, their equilibrium definition does not depend on the informational structure of the model.

we need only to impose a parameter restriction to avoid non-existence of a PBE.[20]

In this subsection, we consider that the upstream supplier offers non-contingent contracts to both downstream firms, while the case of contingent and mixed contracts will be analyzed in the following two subsections. A contract between $\mathcal{U}$ and $\mathcal{D}_i$ is non-contingent if its terms remain intact independently whether the $(\mathcal{U}, \mathcal{D}_j)$ negotiating pair reaches or not an agreement. Stated differently, the (out-of-equilibrium) occurrence of breakdown in the negotiations between the upstream supplier and the downstream firm j does not initiate negotiations anew between $\mathcal{U}$ and $\mathcal{D}_i$, instead the $(\mathcal{U}, \mathcal{D}_i)$ pair abides with its agreed contract terms. By contrast, a contract is contingent when it specifies different contract terms for the case of agreement and for the case of disagreement in the rival bargaining pair. For a thorough discussion of contract contingency see Milliou and Petrakis (2007).

In the last stage, given the demand system in (4) and the contracts $T_i \equiv (w_i, t_i)$ signed between the upstream supplier and the downstream firm i, $i = h, l$, the profits of the downstream firm i and the upstream supplier are

$$\pi_i(p_h, p_l, T_i) = D_i(p_h, p_l)(p_i - w_i) - t_i, \quad i = h, l, \tag{10}$$

$$\Pi(p_h, p_l, T_h, T_l) = D_h(p_h, p_l)w_h + D_l(p_h, p_l)w_l + t_h + t_l. \tag{11}$$

Solving the system of equations defined by the first-order conditions $\frac{\partial \pi_i(\cdot)}{\partial p_i} = 0$ and observing that the second-order conditions are satisfied as long as $u_h > u_l > 0$, it is easy to obtain the equilibrium prices

$$\hat{p}_h(w_h, w_l) = \frac{u_h[2(u_h - u_l + w_h) + w_l]}{4u_h - u_l}, \quad \hat{p}_l(w_h, w_l) = \frac{u_l(u_h - u_l + w_h) + 2u_h w_l}{4u_h - u_l}. \tag{12}$$

Substituting (12) into (10) and (11), the equilibrium downstream and upstream profits

[20] One can check that $u_h > 1.54u_l$ restores the concavity of joint profits. The detailed calculations are available upon request. This condition parallels that in Rey and Vergé (2004), page 734.

are

$$\hat{\pi}_h(T_h, w_l) = \frac{\left[2u_h^2 + u_h(w_l - 2(u_l + w_h)) + u_l w_h\right]^2}{(u_h - u_l)(4u_h - u_l)^2} - t_h, \tag{13}$$

$$\hat{\pi}_l(T_l, w_h) = \frac{u_h\left[u_h(u_l - 2w_l) + u_l(w_h + w_l - u_l)\right]^2}{u_l(u_h - u_l)(4u_h - u_l)^2} - t_l, \tag{14}$$

$$\hat{\Pi}(T_h, T_l) = \frac{u_l\vartheta + u_h u_l w_l(u_h - u_l + 2w_h) + u_h w_l^2(u_l - 2u_h)}{u_l(u_h - u_l)(4u_h - u_l)} + t_h + t_l, \tag{15}$$

with $\vartheta = \left[w_h^2(u_l - 2u_h) + 2u_h w_h(u_h - u_l)\right]$.

We next turn to the bargaining stage. As noted above, in the case of non-contingent contracts, say, the $(\mathcal{U}, \mathcal{D}_h)$ pair cannot include in their bargaining agenda contract terms that will be executed only in the (out-of-equilibrium) case of negotiations breakdown between $\mathcal{U}$ and $\mathcal{D}_l$. This entails that the outside option for the upstream monopolist when bargaining with downstream firm i depends on the equilibrium contract terms signed with firm j.

Let $T_i^N \equiv (w_i^N, t_i^N)$, $i = h, l$, be the equilibrium non-contingent contract signed within the $(\mathcal{U}, \mathcal{D}_i)$ pair. In the bargaining with, say, firm $\mathcal{D}_h$, the outside option of the upstream monopolist is the profit it would earn in case of negotiations breakdown with firm $\mathcal{D}_h$ itself. Should this occur, the upstream supplier still expects to sign the contract T_l^N with downstream firm $\mathcal{D}_l$, which, however, will be a monopolist in the final good market. The outside option for the upstream monopolist is, therefore, $\hat{\Pi}_m(T_l^N)$, whereas the outside option for the downstream firm $\mathcal{D}_h$ is zero (likewise for the bargaining between $\mathcal{U}$ and $\mathcal{D}_l$).[21] Accordingly, the generalized Nash products are

$$NP_h^N(T_h, T_l^N) = \left[\hat{\Pi}(T_h, T_l^N) - \hat{\Pi}_m(T_l^N)\right]^{\mu} \hat{\pi}_h(T_h, w_l^N)^{1-\mu}, \tag{16}$$

$$NP_l^N(T_h^N, T_l) = \left[\hat{\Pi}(T_h^N, T_l) - \hat{\Pi}_m(T_h^N)\right]^{\mu} \hat{\pi}_l(T_l, w_h^N)^{1-\mu}. \tag{17}$$

Standard maximization techniques allow us to find the following equilibrium non-contingent

[21] Inderst and Wey (2003); de Fontenay and Gans (2005) develop an explicit strategic bargaining game to model the idea that the negotiation between parties can come to a breakdown.

contracts.[22]

$$T_h^N = (w_h^N, t_h^N) = \left(\frac{u_l}{4}, \frac{8\mu u_h^3 - 4(1+\mu)u_h^2 u_l + 2(1-\mu)u_h u_l^2 - (1-\mu)u_l^3}{32u_h^2} \right), \quad (18)$$

$$T_l^N = (w_l^N, t_l^N) = \left(\frac{u_l^2}{4u_h}, \frac{u_l[2\mu u_h - (3-\mu)u_l]}{32u_h} \right). \quad (19)$$

Substituting the above back into prices, demands and profits yields the following result.

Lemma 2. *If the upstream supplier offers non-contingent contracts to both downstream firms then the equilibrium contract terms are (18) and (19). The equilibrium prices are* $p_h^N = \frac{2u_h - u_l}{4}$ *and* $p_l^N = \frac{u_l}{4}$*, and the equilibrium demands* $D_h^N = \frac{1}{2}$ *and* $D_l^N = \frac{1}{4}$*. The equilibrium profit of the upstream monopolist is* $\Pi^N = \frac{8\mu u_h^3 - 2\mu u_h^2 u_l + (1-\mu)u_h u_l^2 - (1-\mu)u_l^3}{32u_h^2}$*, and those of the downstream firms are* $\pi_h^N = \frac{(1-\mu)(2u_h - u_l)^2(2u_h + u_l)}{32u_h^2}$ *and* $\pi_l^N = \frac{(1-\mu)u_l(2u_h + u_l)}{32u_h}$*. Finally, the consumer surplus is* $CS^N = \frac{u_h}{8} + \frac{5}{32}u_l$*.*

3.3 Non-exclusive contingent contracts

Contingent contracts capture the idea that bargaining pairs can come to a permanent and irrevocable breakdown in their negotiations.[23] Therefore, a contingent contact between the upstream monopolist and the downstream firm i contains specific terms that will be executed in case that the negotiations between $\mathcal{U}$ and $\mathcal{D}_j$ breakdown. In such a case, the downstream firm i becomes a monopolist in the final good market and the upstream supplier's profit is as under exclusive contracts, namely, $\frac{u_i}{4}\mu$ (see subsection 3.1). The latter is thus the outside option of the upstream supplier in the bargaining with the downstream firm i, while the outside option of the downstream firm is again nil.

As the last stage of the game is unaffected by the contingency or not of the contracts (see

[22] Maximizing first each generalized Nash product $NP_i^N(\cdot)$ w.r.t. t_i, then plugging the solution back into $NP_i^N(\cdot)$, we end up with an expression proportional to the excess joint profits of the $(\mathcal{U}, \mathcal{D}_i)$ pair. Then maximizing these excess joint profits w.r.t. w_i and solving the system of the first order conditions, we obtain the equilibrium contract terms. Second-order conditions are locally satisfied, which, together with the uniqueness of the maximizers, ensures the uniqueness of the solution. The detailed (and cumbersome) calculations are available upon request.

[23] According to Pruitt (2013, p. 73), "Imposing a deadline is a favorite way to dramatize the likelihood of breakdown." Letters of intent can set out deadlines to execute a final agreement, see Lake (1984); Johnson (1992); Peter and Liebeskind (2005).

subsection 3.2 for last stage equilibrium outcomes), the generalized Nash products are

$$NP_h^C(T_h, T_l^C) = \left[\hat{\Pi}(T_h, T_l^C) - \frac{u_l}{4}\mu\right]^{\mu} \hat{\pi}_h(T_h, w_l^C)^{1-\mu}, \tag{20}$$

$$NP_l^C(T_h^C, T_l) = \left[\hat{\Pi}(T_h^C, T_l) - \frac{u_h}{4}\mu\right]^{\mu} \hat{\pi}_l(T_l, w_h^C)^{1-\mu}. \tag{21}$$

where $T_i^C \equiv (w_i^C, t_i^C)$, $i = h, l$, is the equilibrium contingent contract signed between $\mathcal{U}$ and $\mathcal{D}_i$.

Unlike in the case of non-contingent contracts, concavity of the functions (20) and (21) at the critical points identified by the first order conditions (focs) is not always guaranteed. Nevertheless, a sufficient condition that guarantees concavity at the unique solution of the system of the focs is that $\mu \leq \frac{3}{4}$. In fact, if $\frac{3}{4} < \mu \leq 1$, the profit of the low quality downstream firm at the solution of the focs turns out to be negative, thereby violating its participation constraint. Here we will focus on the analysis of the interior solution, relegating that of the corner solution ($\frac{3}{4} < \mu \leq 1$) to the Appendix 4. As we will see, offering two contingent contracts in this latter case turns out to be a dominated strategy for the upstream supplier.

Let $\mu \leq \frac{3}{4}$. Using standard maximization techniques, we obtain the following equilibrium contracts.[24]

$$T_h^C = (w_h^C, t_h^C) = \left(\frac{u_l}{4}, \frac{4\mu(2-\mu)u_h - (3+\mu)u_l)}{16(2-\mu)}\right), \tag{22}$$

$$T_l^C = (w_l^C, t_l^C) = \left(\frac{u_l^2}{4u_h}, \frac{u_l[(-1+6\mu-4\mu^2)u_h - (2-\mu)u_l]}{16(2-\mu)u_h}\right). \tag{23}$$

The following Lemma summarizes our findings.

Lemma 3. *If the upstream supplier offers contingent contracts to both downstream firms then:*

(i) If $\mu \leq \frac{3}{4}$, the equilibrium contract terms are given by (22) and (23). The equilibrium prices are $p_h^C = \frac{2u_h - u_l}{4}$, $p_l^C = \frac{u_l}{4}$, and the equilibrium demands are $D_h^C = \frac{1}{2}$, $D_l^C = \frac{1}{4}$. The equilibrium profits of the upstream monopolist are $\Pi^C = \frac{\mu[4u_h - u_l + 4(1-\mu)(u_h+u_l)]}{16(2-\mu)}$ and

[24] see footnote 22.

those of the downstream firms are $\pi_h^C = \frac{(1-\mu)[4u_h(2-\mu)-5u_l]}{16(2-\mu)}$ *and* $\pi_l^C = \frac{u_l(1-\mu)(3-4\mu)}{16(2-\mu)}$. *The consumer surplus is* $CS^C = \frac{u_h}{8} + \frac{5}{32}u_l$.

(ii) If $\frac{3}{4} < \mu \leq 1$, *in order to satisfy the participation constraint of firm* l *the fixed fee* t_l *should be adjusted downwards relative to case (i) above. In this case, however, non-exclusive contingent contracts are dominated by an exclusive contract offered to the high-quality downstream firm.*

3.4 Non-exclusive mixed contracts

In this subsection we consider the case in which the upstream supplier offers a non-contingent contract to one downstream firm and a contingent contract to the other one. In what follows, we focus on the analysis of the case in which the contingent contract is offered to the low-quality downstream firm and the non-contingent contract to the high-quality one. As is shown in the Appendix 5, the reverse case is always dominated by the upstream supplier offering contingent contracts to both downstream firms.

When $\mathcal{D}_l$ is offered a contingent contract, $\mathcal{D}_h$ knows that in case of a breakdown in its negotiations with the upstream supplier, $\mathcal{U}$ and $\mathcal{D}_l$ will behave as a chain of monopolies. Therefore, the outside option for the upstream supplier in the negotiations with the high quality downstream firm is $\frac{\mu u_l}{4}$. Conversely, the outside option for $\mathcal{U}$ in the negotiations with $\mathcal{D}_l$ stems from the fact that its contract with $\mathcal{D}_h$ cannot include clauses that are contingent on the disagreement between $\mathcal{U}$ and $\mathcal{D}_l$ itself. Letting $T_i^M \equiv (w_i^M, t_i^M)$ be the equilibrium contract signed between $\mathcal{U}$ and $\mathcal{D}_i, i = h, l$, the generalized Nash products are

$$NP_h^M(T_h, T_l^M) = \left[\hat{\Pi}(T_h, T_l^M) - \frac{u_l}{4}\mu\right]^{\mu} \hat{\pi}_h(T_h, w_l^M)^{1-\mu}, \tag{24}$$

$$NP_l^M(T_h^M, T_l) = \left[\hat{\Pi}(T_h^M, T_l) - \hat{\Pi}_m(T_h^M)\right]^{\mu} \hat{\pi}_l(T_l, w_h^M)^{1-\mu}. \tag{25}$$

As in the case of contingent contracts, the generalized Nash products (24) and (25) are not always concave at the solution of the system of the first-order conditions. In particular,

the concavity of $NP_h^M(\cdot)$ is guaranteed either when $\frac{u_l}{u_h} \leq \frac{4}{5}$ or when $\frac{u_l}{u_h} > \frac{4}{5}$ and $\mu \leq \frac{8u_h^2-4u_hu_l-u_l^2}{u_l(6u_h-u_l)} < 1$.[25]

In this parameter constellation, standard maximization techniques lead to the following equilibrium contracts.[26]

$$T_h^M = (w_h^M, t_h^M) = \left(\frac{u_l}{4}, \frac{8\mu u_h^2 - 2\left(3\mu^2 - \mu + 2\right) u_h u_l + (1-\mu)^2 u_l^2}{32u_h} \right), \tag{26}$$

$$T_l^M = (w_l^M, t_l^M) = \left(\frac{u_l^2}{4u_h}, \frac{u_l[2\mu u_h - (3-\mu)u_l]}{32u_h} \right). \tag{27}$$

Note that the fixed fee negotiated with the low-quality downstream firm t_l^M is equal to the respective one under non-contingent contracts t_l^N.This is because t_l^M does not depend on the fixed fee negotiated with the high-quality firm. Yet, the latter differs from the fixed negotiated with the high-quality firm under non-contingent contracts.

The following Lemma summarizes our findings.

Lemma 4. *If the upstream supplier offers a contingent contract to the low-quality downstream firm and a non-contingent contract to the high-quality one then:*

(i) If $\frac{u_l}{u_h} \leq \frac{4}{5}$, *or* $\frac{u_l}{u_h} > \frac{4}{5}$ *and* $\mu \leq \frac{8u_h^2-4u_hu_l-u_l^2}{u_l(6u_h-u_l)} < 1$, *the equilibrium contract terms are given by (26) and (27). The equilibrium prices are* $p_h^M = \frac{2u_h-u_l}{4}$, $p_l^M = \frac{u_l}{4}$, *and the equilibrium demands are* $D_h^M = \frac{1}{2}$, $D_l^M = \frac{1}{4}$. *The equilibrium profits of the upstream supplier are* $\Pi^M = \frac{\mu\left(8u_h^2+(4-6\mu)u_hu_l+(\mu-1)u_l^2\right)}{32u_h}$, *and those of the downstream firms are* $\pi_h^M = \frac{(1-\mu)[8u_h^2-\mu u_l(6u_h-u_l)-(4u_h+u_l)u_l]}{32u_h}$ *and* $\pi_l^M = \frac{(1-\mu)u_l(2u_h+u_l)}{32u_h}$. *The consumer surplus is* $CS^C = \frac{u_h}{8} + \frac{5}{32}u_l$.

(ii) If $\frac{u_l}{u_h} > \frac{4}{5}$ *and* $\frac{8u_h^2-4u_hu_l-u_l^2}{u_l(6u_h-u_l)} < \mu < 1$, *in order to satisfy the participation constraint of firm h the fixed fee* t_h *should be adjusted downwards relative to case (i) above. In*

[25] When these conditions fail to hold, then in the interior solution the high-quality downstream firm makes negative profits and thus, its participation constraint is violated. To keep the high-quality downstream firm in the market, the upstream should adjust the fixed fee downwards. However, as it is shown in Appendix 6, the latter strategy is dominated by the upstream supplier offering an exclusive contract to the high-quality downstream firm.

[26] See footnote 22.

this case, however, non-exclusive mixed contracts are dominated by an exclusive contract offered to the high-quality downstream firm.

Proof. See Appendix 6 for part (ii). □

4 Contract selection

In this section, we determine the optimal pre-contractual arrangement choices by the upstream monopolist. Let $r \equiv \frac{u_l}{u_h}$, with $r \in (0,1)$. The following Proposition states our main result.

Proposition 1. *Let* $\mu_1(r) \equiv \frac{r(1-r)}{6-r}$ *and* $\mu_2(r) \equiv \frac{2(1-r)}{6-r}$, *with* $0 < \mu_1(r) < \mu_2(r) < \frac{3}{4}$. *The upstream supplier offers:*

(i) two non-exclusive, non-contingent contracts for $\mu \in [0, \mu_1(r)]$,

(ii) a non-exclusive, non-contingent contract to downstream firm $\mathcal{D}_h$ *and a non-exclusive, contingent contract to downstream firm* $\mathcal{D}_l$ *for* $\mu \in [\mu_1(r), \mu_2(r)]$,

(iii) two non-exclusive, contingent contracts for $\mu \in [\mu_2(r), \frac{3}{4}]$,

(iv) an exclusive contract to downstream firm $\mathcal{D}_h$ *for* $\mu \in [\frac{3}{4}, 1]$.

Proof. See Appendix 7. □

Figure 1 depicts in the (r, μ)-space the equilibrium pre-contractual arrangement selection by firm $\mathcal{U}$. The bargaining power distribution $(\mu, 1-\mu)$ influences the upstream supplier's choice of the contracts through two main mechanisms. The first mechanism concerns the choice between an exclusive contract and two non-exclusive ones. The second mechanism applies to the class of non-exclusive contracts and refers to whether to make them contingent or not.

As far as the first trade-off is concerned, the forces at stake are as follows. On the one hand, an exclusive contract allows $\mathcal{U}$ to create a monopoly in the downstream market. As a consequence, aggregate industry profits are maximized and are equal to those of a

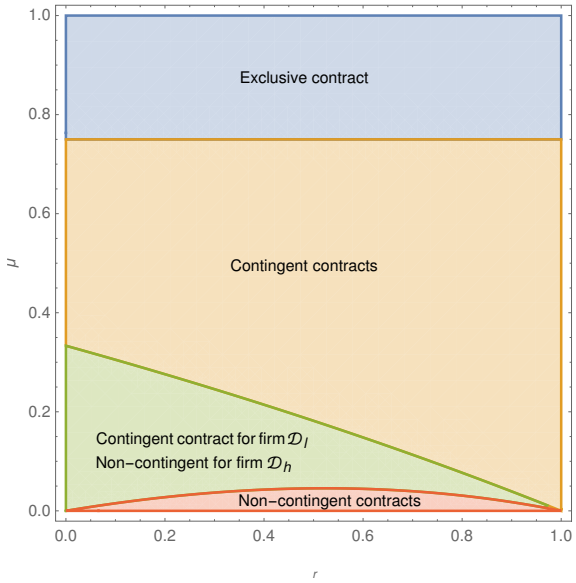


Figure 1: Equilibrium pre-contractual arrangement offers.

vertically integrated monopolist (remember that the equilibrium contract is such that the input price is zero, avoiding thus double-marginalization.) These profits are then apportioned between $\mathcal{U}$ and $\mathcal{D}_h$ according to their respective bargaining powers. Yet, because of contract exclusivity, the upstream supplier has no outside option in the bargaining with $\mathcal{D}_h$, which tends to reduce its equilibrium profits. On the other hand, by selecting non-exclusive contracts, $\mathcal{U}$ enjoys an outside option in its negotiations with each of the downstream firms, which improves its bargaining position for all values of μ. Yet, this comes at the cost of generating a profit-dissipating competition in the downstream market (which is only partially ameliorated by above marginal cost input pricing). The latter, coupled with the well-known upstream monopolist's *commitment problem,* generated by the simultaneous and separate negotiations with the two downstream firms, tends to reduce its equilibrium profits. As a consequence, the upstream supplier prefers to avoid creating competition in the downstream market as long as it has high bargaining power ($\mu > \frac{3}{4}$) and can, therefore, appropriate most of the maximized aggregate industry profits. By contrast, when its bargaining power is lower ($\mu \leq \frac{3}{4}$), $\mathcal{U}$ prefers entering into non-exclusive relationships that generate favorable outside options at

the negotiation stage. By doing so, it strengthens its bargaining position and compensates for the lower bargaining power, at the expense, however, of a reduction in the aggregate industry profits, part of which it could appropriate.

Turning to the choice of the pre-contractual arrangement (contingent vs. non-contingent) within the set of non-exclusive contracts, the intuition is as follows. As we saw above, the equilibrium input prices are independent of the pre-contractual arrangements proposed by $\mathcal{U}$, and also independent of the bargaining power distribution. This implies that the equilibrium joint profits of each vertical chain are the same independently whether $\mathcal{U}$ chooses contingent, non-contingent or mixed non-exclusive contracts. Thus, the upstream firm's choice of contracts influences exclusively its outside options in the negotiations with the downstream firms. It is then easy to see that the higher these outside options, the higher is $\mathcal{U}$'s overall profit from these negotiations. In particular, when $\mathcal{U}$ selects the pre-contractual arrangement to offer to $\mathcal{D}_j$, it actually chooses its *outside option* in the negotiation with $\mathcal{D}_i$. Under a contingent contract with $\mathcal{D}_j$, the outside option of $\mathcal{U}$ in its negotiations with $\mathcal{D}_i$ is its share μ of the vertically integrated monopoly's profit (input price is zero in this case). Clearly, as μ tends to zero, the outside option of $\mathcal{U}$ vanishes. In contrast, under a non-contingent contract with $\mathcal{D}_j$, the variable part of the outside option of $\mathcal{U}$ in its negotiations with $\mathcal{D}_i$, is always strictly positive, because equilibrium input prices are positive and are independent of μ. (Note that under a non-contingent contract, the equilibrium fixed fee t_j will be transferred upstream independently whether there is an agreement or disagreement between $\mathcal{U}$ and $\mathcal{D}_i$, and thus the fixed part of the outside option has virtually no influence on $\mathcal{U}$'s decision). Therefore, when μ is close to zero, $\mathcal{U}$ will opt for two non-contingent contracts to guarantee better overall outside options. When μ is high enough (but not too high), $\mathcal{U}$ will opt for two contingent contracts that lead to higher outside options by avoiding the double marginalization generated by the positive input prices of non-contingent contracts. For intermediate values of μ, mixed contracts are chosen to balance these two opposing forces. It is then easy to see that $\mathcal{U}$ will offer the contingent contract to the low-quality downstream firm in order to strengthen its bargaining position in its negotiations with the high-quality downstream firm that generate

a higher surplus to be shared.

Our discussion reveals that the choice between contingent, non-contingent or mixed contracts will exclusively be based on their impact on the upstream supplier's outside options. One can easily check that for high enough values of the upstream bargaining power, $\mu \in [\mu_2(r), \frac{3}{4}]$, the most favorable outside options for $\mathcal{U}$ are guaranteed by two contingent contracts: $\frac{\mu u_h}{4} > \max\{\hat{\Pi}_m(T_h^N), \hat{\Pi}_m(T_h^M)\}$ and $\frac{\mu u_l}{4} > \max\{\hat{\Pi}_m(T_l^N), \hat{\Pi}_m(T_l^Z)\}$.[27] As μ decreases, $\mu \in [\mu_1(r), \mu_2(r)]$, the outside option in the negotiation with $\mathcal{D}_l$ becomes larger with a non-contingent than with a contingent contract signed with $\mathcal{D}_h$: $\hat{\Pi}_m(T_h^M) > \max\{\hat{\Pi}_m(T_h^N), \frac{\mu u_h}{4}\}$, while $\frac{\mu u_l}{4}$ is still a larger outside option in the negotiation with $\mathcal{D}_l$. Lastly, when μ is small, $\mu \in [0, \mu_1(r)]$, also the outside option in the negotiation with $\mathcal{D}_h$ becomes larger under a non-contingent contract: $\hat{\Pi}_m(T_h^N) > \max\{\hat{\Pi}_m(T_h^M), \frac{\mu u_h}{4}\}$ and $\hat{\Pi}_m(T_l^N) > \max\{\hat{\Pi}_m(T_h^Z), \frac{\mu u_l}{4}\}$. The latter sheds light on why the upstream supplier never finds it optimal to offer a contingent contract to $\mathcal{D}_h$ and a non-contingent contract to $\mathcal{D}_l$.

To the best of our knowledge, scant research has been conducted on the relationship between the distribution of bargaining power and the structure of contracts, let alone their (non-)contingency on other deals reached by one party. Yet, some evidence can be found in Choi and Triantis (2012), who observe that in the market for loans, "covenant-lite" loans – i.e. loans whose contracts contain "few" clauses – are found in situations where the lenders have low bargaining power relative to the borrowers. This is consistent with our finding that when $\mathcal{U}$ has a relatively high bargaining power, it selects contingent contracts that are more complex than non-contingent ones, which are offered instead when the upstream supplier has a low bargaining power.[28]

Figure 1 also points out the role of the degree of product differentiation r on the choice

[27] $\hat{\Pi}_m(T_h^N) \equiv \frac{u_l^2(u_h-u_l)+\mu(2u_h-u_l)^2(2u_h+u_l)}{32u_h^2}$, $\hat{\Pi}_m(T_l^N) \equiv \frac{u_l[\mu u_h(2u_h+u_l)+u_l(u_h-u_l)]}{32u_h^2}$ and $\hat{\Pi}_m(T_h^M) \equiv \frac{\mu\left[8u_h^2-(6\mu-2)u_h u_l-(2-\mu)u_l^2\right]}{32u_h}$. Finally, $\hat{\Pi}_m(T_l^Z) \equiv \frac{\mu u_l\left[(6-4\mu)u_h^2+2(2-\mu)u_h u_l-(2-\mu)u_l^2\right]}{32u_h^2}$ is the outside option with D_h in the (out-of equilibrium) case where a contingent contract is offered to firm D_h and a non-contingent one to firm D_l (see Appendix 5).

[28] Gopal *et al.* (2003), analyzing the contracts governing offshore software development, find that the probability of observing "time-and-materials" supply contracts, i.e. contracts that are contingent on the possible variation of the cost of the project, as opposite to "fixed-price" contracts, increase when buyers have a limited bargaining power.

of contracts. It is easy to ascertain that r does not affect the choice between exclusive and non-exclusive contracts. Yet, it influences the likelihood with which alternative configurations of non-exclusive contracts are offered by the upstream supplier if μ is not too high. In particular, as product differentiation decreases (higher r), mixed contracts become less attractive relative to contingent ones ($\mu_2(r)$ is decreasing in r). Intuitively, as products become less differentiated, the downstream firms' performances tend to become similar, which makes it less and less profitable for the upstream supplier to offer them different type of non-exclusive contracts. By contrast, non-contingent contracts become more attractive for intermediate values of product differentiation ($\mu_1(r)$ is inverted-U shaped). For low levels of r, products are very differentiated, and the intuition above applies: increasing r makes products more alike, thus making mixed contracts less attractive than non-contingent ones. However, as products become more homogeneous, the upstream supplier's outside options with non-contingent contracts substantially decrease, and become thus eventually dominated by mixed non-exclusive contracts.[29]

5 Discussion of equilibrium outcomes

As we discussed above, the equilibrium input prices coincide for all non-exclusive contracts, irrespective of the pre-contractual arrangement. This implies that equilibrium final goods prices, demands and consumer surplus are the same too (see Lemmata 2, 3 and 4). By contrast, the profits accruing to the upstream supplier and to the downstream firms differ, because the equilibrium fixed fees are different under contingent, non-contingent and mixed contracts, reflecting the differences in the upstream supplier's outside options.

Interestingly, the fixed fees may be positive or negative depending on the bargaining power distribution, as reported in the following Lemma. Letting $R_l^i \equiv w_l^i D_l^i + t_l^i$, $i \in \{C, M, N\}$ be the upstream supplier's profits from selling input to the low-quality firm, we obtain the following results.

[29] Remember that, in a non-contingent contract, the outside option depends on the degree of product differentiation, whereas in a contingent contract, it does not.

Lemma 5. *(i) If the optimal contracts are non-contingent (i.e., $\mu \in [0, \mu_1(r)]$), then the fixed fees, t_h^N and t_l^N, are both negative; moreover, $R_l^N < 0$.*

(ii) If the optimal contracts are mixed (i.e., $\mu \in [\mu_1(r), \mu_2(r)]$), then:

$$\forall r > 0.448 \quad \Rightarrow t_h^M < 0, \ \textit{otherwise} \quad t_h^M \gtreqless 0 \Leftrightarrow \mu \gtreqless \frac{4 + r - r^2 - \sqrt{16 + 8r - 31r^2 + 8r^3}}{(6r - r^2)} \equiv \mu_h^M(r)$$

$$\forall r > 0.202 \quad \Rightarrow t_l^M < 0, \ \textit{otherwise} \quad t_l^M \gtreqless 0 \Leftrightarrow \mu \gtreqless \frac{3r}{2 + r} \equiv \mu_l^M(r)$$

$$\forall r > 0.472 \quad \Rightarrow R_l^M < 0, \ \textit{otherwise} \quad R_l^M \gtreqless 0 \Leftrightarrow \mu \gtreqless \frac{r}{2 + r} \equiv \mu_R^M(r)$$

(iii) If the optimal contracts are contingent (i.e., $\mu \in [\mu_2(r), 3/4]$), then:

$$t_h^C \gtreqless 0 \quad \Leftrightarrow \mu \quad \gtreqless \frac{8 - r - \sqrt{64 - 64r + r^2}}{8} \equiv \mu_h^C(r)$$

$$t_l^C \gtreqless 0 \quad \Leftrightarrow \mu \quad \gtreqless \frac{6 + r - \sqrt{20 - 20r + r^2}}{8} \equiv \mu_l^C(r)$$

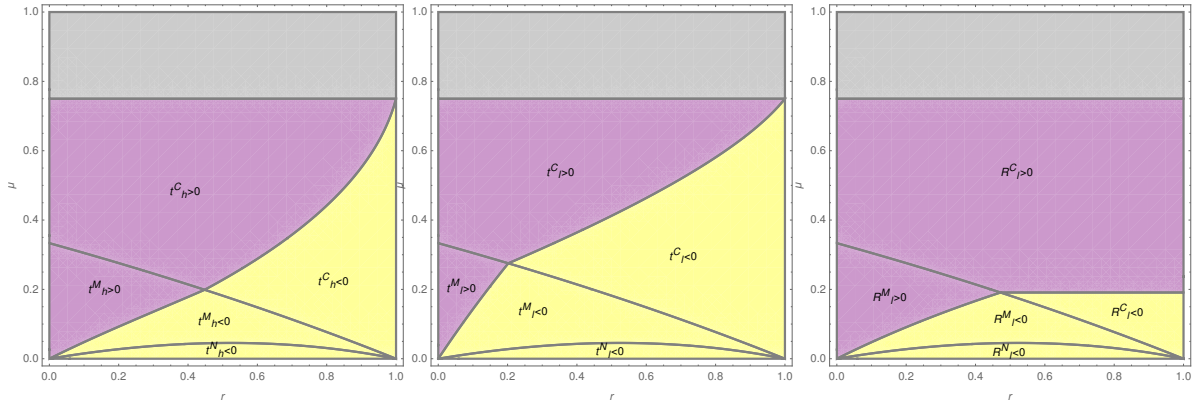
$$R_l^C \gtreqless 0 \quad \Leftrightarrow \mu \quad \gtreqless \frac{3 - \sqrt{5}}{4} \equiv \mu_R^C(r)$$

Figure 2 depicts the various regions described in Lemma 5. In the purple-shaded areas the respective variables take positive values, whereas in the yellow-shaded areas they take negative values.

For all non-exclusive contracts, if the bargaining power of the upstream supplier is large (μ high), the share of the excess joint profits of each vertical chain accruing, via the fixed fee, to the upstream supplier is large. As μ decreases, the fixed fees shrink. Ultimately, when μ becomes sufficiently small, the fixed fees become *negative*: the upstream monopolist partially subsidizes, through the fixed fees, the downstream firms, yet it receives positive payments via sales at input prices above its marginal cost. Surprisingly, the non-exclusive contract offered to the low-quality downstream firm can, in fact, generate losses for the upstream supplier, i.e., the positive revenues from input sales can be lower than the negative fixed fee (see yellow region in Figure 2c).[30] In this case, the upstream supplier optimally suffers such a loss in

[30] Note that for any μ we have $R_h^i = w_h^i D_h^i + t_h^i > 0$, i.e., the contract offered to the high-quality firm generates always gains for the upstream supplier.

order to gain a stronger outside option in the negotiations with the high-quality downstream firm that sells the "high value-added" product. The above are particularly relevant under non-contingent contracts in which case both fixed fees t_h^N and t_l^N are always negative and at the same time, the revenue collected by input sales to $\mathcal{D}_l$ does not cover the negative fixed fee - transfer downstream (i.e., $R_l^N < 0$).



(a) t_h^C, t_h^M (b) t_l^C, t_l^M (c) R_l^C, R_l^M

Figure 2: Optimal tariffs and total profit from $\mathcal{D}_l$ under Contingent and Mixed equilibrium contracts.

The following Proposition summarizes our findings.

Proposition 2. *Under non-contingent, non-exclusive equilibrium contracts, the fixed fees always act as subsidies to the downstream firms, and moreover, the contract offered to the low-quality downstream firm generates a loss for the upstream supplier. These observations hold also under contingent and mixed, non-exclusive equilibrium contracts as long as the bargaining power of the upstream supplier is sufficiently low.*

Note that the parameter space in which fixed fees are negative grows larger as the products become less differentiated (as r increases). Intuitively, the less differentiated the products, the smaller the industry producer surplus to be shared among the upstream supplier and the downstream firms. As downstream firms pay positive input prices, but should still earn overall non-negative profits, a higher part of the industry producer surplus accrues to them as the goods become less differentiated. Although Iozzi and Valletti (2014)' setup is quite different

than ours, our findings on the impact of product differentiation on equilibrium contractual terms have a similar flavor to theirs. Under Bertrand competition with horizontally differentiated goods and linear non-contingent contracts, Iozzi and Valletti (2014) show that input prices increase with the degree of product differentiation when breakdowns are observable. This is, to a major extent, consistent with our finding that under non-contingent contracts, the higher the degree of vertical product differentiation (the lower r), the higher are the fixed fees for given bargaining power distribution.[31]

In contrast to non-exclusive contracts, under an exclusive contract, the equilibrium input price is equal to the upstream marginal cost and the equilibrium contract terms maximize aggregate industry profits. Yet, from a total welfare standpoint, our analysis shares the concerns about the anti-competitiveness of foreclosure: Total welfare is lower under exclusive contracts than under non-exclusive ones. A strong indication in this direction is the fact that the demand for the high-quality good under an exclusive contract is the same as the one under non-exclusive contacts, yet in this latter case, the low-quality good is consumed too.

6 Concluding Remarks

We have investigated the optimal pre-contractual arrangement offers of an upstream monopolist that may sell an essential input to two downstream firms that produce vertically differentiated goods and compete in prices in the final goods market.

We show that the distribution of the bargaining power and the degree of vertical product differentiation play a crucial role in determining the equilibrium outcome. In particular, when the bargaining power of the upstream supplier is relatively high, it prefers to sign an exclusive contract with the high-quality downstream firm. It thus avoids downstream competition that erodes aggregate industry profits and moreover, it extracts most of the producer surplus generated by the ensuing vertically integrated market structure. For lower values of bargaining power, the upstream supplier opts for non-exclusive contracts. In this way, the upstream

[31] Note however that for given u_l, the negotiated input price for the low quality firm increases with r (see Lemma 2).

supplier generates outside options in its negotiations with the downstream firms, at the cost however of increasing downstream competition. By strengthening its bargaining position, it obtains a larger share of an otherwise smaller industry producer surplus and increases thus its profits. Further, we show that for intermediate bargaining power values, the upstream supplier prefers to offer contingent contracts to both downstream firms; whereas for lower values, it opts for mixed contracts, i.e., a contingent contract to the low-quality downstream firm and a non-contingent to the high-quality one. Finally, the upstream supplier offers non-contingent contracts to both downstream firms only if the upstream bargaining power is quite low.

Consumer surplus and total welfare are lower under an exclusive contract than under any configuration of non-exclusive contracts. This is mainly because the equilibrium quantity of the high quality good is the same under all contract configurations, however under non-exclusive contracts the low quality good is consumed in equilibrium as well. By offering an exclusive contract, a powerful upstream supplier forecloses the low quality downstream firm from the market, increasing its own profits but simultaneously harming consumers and one downstream firm. This is a clear case of abuse of dominant position that goes under the auspices of the antitrust authorities and should be sanctioned as it reduces all welfare standards. By contrast, the (non-)contingency clauses included in non-exclusive contracts are welfare neutral, entailing that this class of clauses should not pose concerns to competition authorities.

A legitimate question concerns the robustness of our findings to alternative modeling specifications. Quantity competition, instead of price competition, in the downstream market does not qualitatively alter our results. The only relevant difference is that the input prices are always below the upstream marginal cost, which makes the outside options under non-contingent contracts negative for low μ. As a consequence, offering two non-contingent pre-contractual arrangements is never optimal for $\mathcal{U}$. Furthermore, considering (symmetrically) horizontally differentiated goods (Bowley, 1924, Spence, 1976, Dixit, 1979) does not affect the message of our analysis. In this case, if we replace the degree of vertical product differentiation

with the degree of product substitutability, we obtain a similar partition of the parameter space regarding the upstream supplier's contract choices. The relevant difference in such a case is that, due to the symmetry of the horizontal differentiation model, firm U never offers different pre-contractual arrangements to downstream firms.[32]

Our analysis leads to a number of testable implications. In markets with a powerful upstream supplier, we should observe foreclosure in the downstream market. In particular, low-quality downstream firms are expected to be foreclosed by the upstream monopolist. By contrast, when the upstream supplier is not so powerful, we should observe non-exclusive contracts offered to downstream firms. In addition, the "complexity" of non-exclusive contracts is expected to be positively related to the bargaining power of the upstream supplier: More powerful suppliers should sign contracts including clauses that allow for renegotiation in case of an increase in downstream concentration, whereas in contracts signed by less powerful upstream suppliers, such clauses are expected to be absent.[33] Furthermore, mixed contracts should mainly be observed in markets where goods dispose some vertical product differentiation characteristics, whereas they should be much less common in markets for horizontally differentiated goods. Finally, in markets with quantity competition, exclusive contracts should be observed more frequently than in markets characterized by price competition.

Our analysis suggests several lines for future research. First, one direction is to consider that the two downstream firms have different bargaining powers relative to the upstream supplier. We expect that, as long as the asymmetry in bargaining powers is not too large, our intuitive arguments concerning the choice between exclusive and non-exclusive contracts would apply in this case too. However, due to the asymmetry in bargaining powers, mixed contracts with a contingent contract offered to high-quality firm and a non-contingent to the low-quality firm could emerge. Another direction is to let the number of competing downstream firms increase. The configuration of contracts to be offered by the upstream supplier is expected to be richer now, but the upstream bargaining power will still play a significant role in its choice

[32] A thorough discussion of these extensions is available in the working paper WP DSE 1079.

[33] Some evidence regarding the "complexity" of contracts in general confirms this point, see page 24 and footnote 28.

of specific contracts. One should expect that the higher the upstream bargaining power, the more concentrated the downstream market will be. Finally, the possibility of sequential bargaining between the upstream supplier and the downstream firms could be explored. In this case, $\mathcal{U}$ could commit to a negotiation sequence at the pre-contractual stage in order to exploit optimally its outside options.

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Appendix

1 Pre-contractual liablity: some cases.

In Hoffman vs. Red Owl Stores, Mr. Hoffman, without signing a formal contract, agreed with a representative of Red Owl to open a Red Owl franchise, at the cost of 18,000$; to do so, he sold its own business and moved to another city. The actual cost to start the new business was substantially higher than what outlined by Red Owl, and no agreement was found on how to finance it. The court held Red Owl responsible for the unkept promise and made it pay for the losses incurred by Mr. Hoffman. In Pennzoil vs. Texaco, Pennzoil signed a "Memorandum of Agreement" with Getty Oil for acquiring it, but before the takeover took place, Texaco offered a better price to the owners of Getty, who accepted this second deal. Pennzoil sued Texaco and obtained the payment of damages because the pre-contractual agreement, though not formal, was binding. In Channel Home Centers vs. Grossman, the parties signed a letter of intent that -among other things- engaged Grossman, the perspective owner of a commercial premise, to withdraw the premise itself from the rental market while negotiating with Channel Home over the lease terms. When Grossman received a better lease offer from a third party, he broke the negotiations with Channel Home. The courts final decision was that the letter of intent actually constrained the parties to negotiate in good faith to a complete contract so that breaking up the negotiation because of a better offer was sanctionable. A similar, though more complex, case is Teachers Insurance and Annuity Association vs. Tribune Co. In Italy, an analogue case, though involving a State-controlled conglomerate is IRI vs. Butoni. For a more detailed analysis of these, and other, cases see, e.g. Stefani (1986); Farnsworth (1990); Lockhart (1996); Schwartz and Scott (2007).

2 Letter of intent

With a letter of intent, a party sets forth its intention to sign a contract in the circumstances reported in the letter. It is worth noticing that "A letter of intent is not itself a formal contract but certain of its provisions (e.g. concerning payment for any work completed) may nevertheless be enforceable. Letters of intent are widely used in the UK construction industry, where their usual purpose is to encourage a contractor to begin work on a time-sensitive project before legal formalities have been completed. Recent case law suggests that the courts are increasingly willing to find that a letter of intent constitutes a binding contract, provided that all necessary elements of a contract are present [...]" Law (2016).

3 Contingency in pre-contractual arrangements

Pre-contractual arrangements may contain contingent clauses, see e.g. Farnsworth (1987); Schwartz and Scott (2007); Mouzas and Furmston (2008). While describing the possible features of the letters of intent, Draetta and Lake (1993) observe (p. 861) that some "may become binding contracts only on the execution of another agreement between one or both of the parties to the letter of intent and a third party", which is typically the case of financing agreements. Also (p.862), they remark that some pre-contractual arrangements, "pre-bid letters of intent", may contain "second look" clauses, which condition the terms of trade between two parties A and B on a possible, more interesting, proposal received by -say- A from a third party. They conclude that (p.863) "[o]ne peculiarity of the types of framework letters of intent examined here is that their binding effect is conditional on the successful outcome of a negotiation that one of the parties has to conduct with a third party".

4 Contingent contracts: case $\frac{3}{4} < \mu \leq 1$

Assume that $\frac{3}{4} < \mu \leq 1$. In this parameter region the low-quality downstream firm cannot reap non-negative profits at the interior solution of the system of the Nash products. As a

consequence, the candidate equilibrium contract must be constrained such that firm $\mathcal{D}_l$ is willing to enter the agreement. Such a contract must still maximize the excess joint profits of the $(\mathcal{U}, \mathcal{D}_l)$ pair which, because of the foregoing observation, completely accrue to the upstream supplier. The fixed fee t_l is thus set so that the downstream firm is indifferent between signing or not the contract. Thus, the candidate equilibrium contracts are obtained by solving the following problem

$$\max_{w_h, t_h} NP_h^C(T_h, T_l^C), \quad \max_{w_l}[\hat{\Pi}(T_h^C, T_l) + \hat{\pi}_l(T_l, w_h^C)], \text{ and } \hat{\pi}_l(T_l, w_h^C) \overset{t_l}{=} 0. \tag{28}$$

The candidate equilibrium contracts are then

$$T_h^C = (w_h^C, t_h^C) = \left(\frac{u_l}{4}, \frac{4u_h\mu + u_l(-3 + (3-4\mu)\mu)}{16}\right) \tag{29}$$

$$T_l^C = (w_l^C, t_l^C) = \left(\frac{u_l^2}{4u_h}, \frac{u_l(u_h - u_l)}{16u_h}\right). \tag{30}$$

The candidate equilibrium prices are $p_h^C = \frac{2u_h - u_l}{4}$, $p_l^C = \frac{u_l}{4}$, and the candidate equilibrium demands are $D_h^C = \frac{1}{2}$, $D_l^C = \frac{1}{4}$. The candidate equilibrium profit of the upstream supplier is $\Pi^C = \frac{\mu[4u_h + u_l(3-4\mu)]}{16} < \Pi_m^*$. Such a contract is then strictly dominated, for firm $\mathcal{U}$ by an exclusive contract.

5 Contingent high-quality contract and non-contingent low-quality contract

Let us consider the case in which $\mathcal{U}$ offers a contingent contract to $\mathcal{D}_h$ and a non-contingent contract to $\mathcal{D}_l$. Let $T_i^Z \equiv (w_i^Z, t_i^Z), i = h, l$ be the candidate equilibrium contracts. Using similar arguments as in (3.3) to determine the outside options for the upstream supplier, the

generalized Nash products are

$$NP_h^Z(T_h, T_l^Z) = \left[\hat{\Pi}(T_h, T_l^Z) - \hat{\Pi}_m(T_l^Z)\right]^{\mu} \hat{\pi}_h(T_h, w_l^Z)^{1-\mu}, \tag{31}$$

$$NP_l^Z(T_h^Z, T_l) = \left[\hat{\Pi}(T_h^Z, T_l) - \frac{u_h}{4}\mu\right]^{\mu} \hat{\pi}_l(T_l, w_h^Z)^{1-\mu}. \tag{32}$$

As in (3.3), (31) and (32) are locally concave at the solution of the FOCs only if $\mu \leq \frac{2u_h^2+2u_hu_l-u_l^2}{4u_h^2+2u_hu_l-u_l^2}$ (otherwise, $NP_l^Z(\cdot)$ is no longer locally concave because $\mathcal{D}_l$ earns negative profits). If this condition holds, standard maximization techniques lead to the following equilibrium contracts

$$T_h^Z = (w_h^Z, t_h^Z) = \left(\frac{u_l}{4}, \frac{8\mu u_h^3 - 4(1+\mu)u_h^2u_l + 2(1-\mu)u_hu_l^2 - (1-\mu)u_l^3}{32u_h^2}\right), \tag{33}$$

$$T_l^Z = (w_l^Z, t_l^Z) = \left(\frac{u_l^2}{4u_h}, \frac{u_l\left\{2\mu(3-2\mu)u_h^2 + 2[(2-\mu)\mu - 2]u_hu_l + (1-\mu)^2u_l^2\right\}}{32u_h^2}\right). \tag{34}$$

Note that as the generalized Nash products $NP_h^Z(T_h, T_l^Z)$ and $NP_h^N(T_h, T_l^N)$ are identical and do not depend on the fixed fee offered to $\mathcal{D}_l$, then $T_h^Z = T_h^N$. Then the equilibrium final good prices are $p_h^Z = \frac{2u_h-u_l}{4}$, $p_l^Z = \frac{u_l}{4}$, and the candidate equilibrium demands are $D_h^Z = \frac{1}{2}$, $D_l^Z = \frac{1}{4}$. The equilibrium profits of the upstream supplier is $\Pi^Z = \frac{\mu\left[8u_h^3+(2-4\mu)u_h^2u_l-2(\mu-1)u_hu_l^2+(\mu-1)u_l^3\right]}{32u_h^2}$.

If $\mu > \frac{2u_h^2+2u_hu_l-u_l^2}{4u_h^2+2u_hu_l-u_l^2}$, the fixed fee has to be constrained in order to incentivize the low quality firm to sign the contract. Then the optimal contracts are the solution to

$$\max_{w_h, t_h} NP_h^Z(T_h, T_l^Z), \quad \max_{w_l}[\hat{\Pi}(T_h^Z, T_l) + \hat{\pi}_l(w_h^Z, T_l)], \text{ and } \hat{\pi}_l(w_h^Z, T_l) \overset{t_l}{=} 0. \tag{35}$$

Standard maximization techniques then lead to the following.

$$T_h^Z = (w_h^Z, t_h^Z) = \left(\frac{u_l}{4}, \frac{8\mu u_h^3 - 4(1+\mu)u_h^2u_l + 2(1-\mu)u_hu_l^2 - (1-\mu)u_l^3}{32u_h^2}\right), \tag{36}$$

$$T_l^Z = (w_l^Z, t_l^Z) = \left(\frac{u_l^2}{4u_h}, \frac{u_l(u_h - u_l)}{16u_h}\right). \tag{37}$$

The final good prices and demands at the candidate equilibrium are as above, while the candi-

date equilibrium profits of the upstream supplier is $\Pi^Z = \frac{u_l\left(2u_h^2+2u_hu_l-u_l^2\right)+\mu(2u_h+u_l)(2u_h-u_l)^2}{32u_h^2}$.

Note that as $\Pi^Z < \Pi^C$, a non-contingent contract offered to $\mathcal{D}_l$ and a contingent contract to $\mathcal{D}_h$ is strictly dominated for the upstream supplier by offering two contingent contracts.

6 Proof of Lemma 4 part ii)

If $\mathcal{U}$ offers a contingent contract to $\mathcal{D}_l$ and a non-contingent contract to $\mathcal{D}_h$ and $\frac{u_l}{u_h} > \frac{4}{5}$ and $\frac{8u_h^2-4u_hu_l-u_l^2}{u_l(6u_h-u_l)} < \mu < 1$, at the interior solution the high-quality downstream firm makes negative profits. The fixed fee must be constrained to incentivize $\mathcal{D}_h$ to sign the contract. The candidate equilibrium contracts are then the solution to the following problem

$$\max_{w_l,t_l} NP_l^M(T_h^M,T_l), \quad \max_{w_h}[\hat{\Pi}(T_h,T_l^M)+\hat{\pi}_h(T_h,w_l^M)], \text{ and } \hat{\pi}_h(T_h,w_l^M) \overset{t_h}{=} 0. \tag{38}$$

Thus, the candidate equilibrium contracts are

$$T_h^M = (w_h^M,t_h^M) = \left(\frac{u_l}{4}, \frac{u_h-u_l}{4}\right), \tag{39}$$

$$T_l^M = (w_l^M,t_l^M) = \left(\frac{u_l^2}{4u_h}, \frac{u_l[2\mu u_h-(3-\mu)u_l]}{32u_h}\right). \tag{40}$$

The candidate equilibrium prices are $p_h^M = \frac{2u_h-u_l}{4}$, $p_l^M = \frac{u_l}{4}$, and the candidate equilibrium demands are $D_h^M = \frac{1}{2}$, $D_l^M = \frac{1}{4}$. The candidate equilibrium profit of the upstream supplier is $\Pi^M = \frac{8u_h^2-2(2-\mu)u_hu_l-(1-\mu)u_l^2}{32u_h} < \Pi_m^*$. For firm $\mathcal{U}$, this pair of contracts is strictly dominated by an exclusive contract offered to the high-quality firm.

7 Proof of Proposition 1

As we have seen above, all the candidate equilibrium contracts in which the fixed fee is adjusted so as to motivate either firm $\mathcal{D}_h$ or $\mathcal{D}_l$ to sign the contract are strictly dominated, for firm $\mathcal{U}$ by an exclusive contract offered to $\mathcal{D}_h$ (see Appendix 4 and 6). In addition, offering a non-contingent contract to $\mathcal{D}_l$ and a contingent one to $\mathcal{D}_h$ is also strictly dominated by

contingent contracts offered to both downstream firms (see Appendix 5).

After the elimination of strictly dominated strategies, we determine the optimal pre-contractual offers by firm $\mathcal{U}$ by comparing its profits at the equilibria of each subgame.

(i) if $\mu \in [0, \mu_1(r))$, then $\Pi^N > \max[\Pi_m^*, \Pi^M, \Pi^C]$,

(ii) if $\mu \in [\mu_1(r), \mu_2(r))$, then $\Pi^M > \max[\Pi_m^*, \Pi^N, \Pi^C]$,

(iii) if $\mu \in [\mu_2(r), \frac{3}{4})$, then $\Pi^C > \max[\Pi_m^*, \Pi^N, \Pi^M]$,

(iv) if $\mu \in [\frac{3}{4}, 1]$, then $\Pi_m^* > \max[\Pi^C, \Pi^N, \Pi^M]$,

with $r \equiv \frac{u_l}{u_h}$, $\mu_1(r) \equiv \frac{r(1-r)}{(6-r)}$, $\mu_2(r) \equiv \frac{2(1-r)}{6-r}$, and $0 < \mu_1(r) < \mu_2(r) < \dfrac{3}{4}$.