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Efficiency Effects of Regulations on Unfair Subcontracting Behaviors†

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This paper investigates the efficiency effects of governing vertical relationships by analyzing the incentives of firms to engage in exclusive contracts. In particular, the analysis focuses on the subcontracting context. When a downstream firm possesses a superior bargaining position, upstream subcontractors do not prefer an exclusive contract, even when it is efficient, as such a contract lowers their bargaining power even further, ultimately leading to lower profits. It can therefore enhance efficiency to encourage upstream firms to engage in an exclusive contract by limiting bargaining power abuses by superior downstream firms. The paper discusses the required flexibility of such a regulation as well as the evaluation of the current regulation based on the analysis.

Key Words: Subcontracting, Efficiency, Hold-up, Bargaining Power, Exclusive Contract
JEL Code: L13, L14, L42

I. Introduction

The Korea Fair Trade Commission (KFTC hereafter) is a competition authority, but it also promotes fair transactions in vertical relationships by enforcing four acts, including the "Fair Transactions in Subcontracting Act" (the Subcontracting Act hereafter). It can be regarded as a contradiction for a competition authority to enforce these acts (see Choi, 2023, for example). If the purpose of these acts is limited to protecting small firms, it would not be desirable for KFTC to be held responsible for governing vertical relationships. It can be justified, however, if these acts also contribute to competition-friendly trade environments. This paper

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TABLE 1—NUMBER OF UNFAIR SUBCONTRACTING BEHAVIOR CASES FROM 2014 TO 2023

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Finalized	1,486	1,942	1,657	1,296	1,818	1,373	1,166	1,431	841	1,145
Ruled Illegal	911	1,358	1,035	782	874	680	538	993	446	786

Source: fairdata.go.kr (latest access on 23 Jan 2025)

investigates the efficiency effects of governing vertical relationships by analyzing the incentives that drive firms to utilize exclusive contracts. In particular, the analysis focuses on the subcontracting context.

The Subcontracting Act aims to reduce unfair subcontracting practices.[1] The number of unfair practices that have been ruled illegal has decreased and stabilized recently, partly due to the successful enforcement of the Act. Unfair practices are compelled through abuse of a superior position.[2] Unfair requests would not be accepted if there were small differences in bargaining power. The Subcontracting Act is indeed a special act, conceptualizing the abuse of a superior position in the "Monopoly Regulation and Fair Trade Act"[3] in the subcontracting context. It is not always the case that a downstream firm is in a superior position in a subcontracting relationship.[4] A downstream firm smaller than a subcontractor may not successfully enforce its desired terms and conditions. For these reasons, the Subcontracting Act makes it clear that the Act applies to subcontracting transactions in which the sales of a downstream firm exceed that of a subcontractor.[5] Given that this paper focuses on the efficiency effects of Subcontracting Act, it is assumed throughout the paper that a downstream firm has a superior bargaining position.

Subcontracting transactions sometimes entail exclusivity, which enlarges gaps in the bargaining power between the parties. In some cases, such differences in bargaining power are fully exploited. When a downstream firm possesses a superior position in bargaining, it can be tempted to squeeze profits out of subcontractors. Upstream subcontractors that may be exploited would not prefer exclusive relationships. Hence, cases can exist in which such exploitative abuse must be deemed unreasonable and prohibited in order to promote exclusive subcontracting trades.

The appropriate question here is what behaviors must be prohibited. There can be a debate over which value must be assigned more weight between fairness and efficiency, but there must be unanimous agreement over the prohibition of behaviors that undermine both fairness and efficiency. In this regard, this paper investigates

[1]The Subcontracting Act was enacted in December of 1984 and entered into force in April of 1985. At that time, unfair practices were increasing in subcontracting transactions which had been used intensively in the manufacturing sector since 1975.

[2]Lee and Lee (2012) show that differences in bargaining power have a significant impact on the frequency of unreasonable pricing.

[3]Article 45, Clause 1, Item 6 of "Monopoly Regulation and Fair Trade Act" regards the misuse of a superior position in transactions as illegal.

[4]For example, a fashion designer who wants to produce clothes may request textile companies to manufacture them according to a certain design. A cosmetics producer may want to outsource manufacturing tasks to large companies after finishing the planning and designing stages of the production process.

[5]More specifically, Article 2 of the Act says that the Act applies to the cases where (i) a downstream firm is not a small and medium-sized enterprise (SME, hereafter) and a subcontractor is an SME, or (ii) a downstream firm is an SME and has a higher sales volume than a subcontractor who is also an SME.

whether enhancing fairness can lead to higher efficiency. More specifically, this paper presents a scenario in which the prohibition of exploitative behaviors promotes an exclusive contract that is efficient. To this end, it is necessary to begin by asking why and when an exclusive contract would be more efficient in the context of subcontracting, and then to investigate what behaviors prevent an efficient contract from being realized.

The theory of exclusive dealing provides a clue with regard to answering the questions above. Section 2 begins with why and when an exclusive contract is more efficient. Essentially, an exclusive contract mitigates some costs and facilitates certain actions, thus enhancing efficiency. Obviously, it is not always the case that efficiency is promoted by exclusivity, but the central problem is that an exclusive contract may not be made even when it increases efficiency, and the theory of exclusive dealing says that this is due to a hold-up problem. By an analogous logic, there is a case in which an exclusive contract reduces costs but lowers the profits of subcontractors.

Section 3 shows theoretically that this can indeed occur. When two downstream firms have higher bargaining power than two upstream firms, an exclusive contract lowers the bargaining power of the upstream firms even further, yielding them lower profits. This is why upstream firms do not want to enter into an exclusive contract and thus why efficiency is not achieved. Downstream firms can incentivize upstream firms to engage in an efficient contract by guaranteeing them higher profits, which improves efficiency, but they may fail to do so when they are not able to make a long-term commitment.

This result has several policy implications. Section 4 discusses an appropriate form of regulation consistent with the result, suggesting that the Subcontracting Act must be revised toward this form. Issues related to implementation are also explored. Section 5 concludes the paper.

II. Exclusive Dealing

It is useful to refer to the theory of exclusive dealing in order to see whether limiting the bargaining power of a downstream firm against subcontractors would enhance efficiency by any chance. Exclusive dealing is a way of transacting that excludes competitors on one or both sides of the trade. Exclusive dealing exists in many industries. For example, Costco accepts only VISA credit cards internationally, and only the Hyundai card in Korea. It had accepted only American Express cards internationally, and only the Samsung card in Korea before. It claims that exclusive dealing is an effective means of lowering transaction fees (including multilateral interchange fees) and consequently the prices of its commodities.

Exclusive dealing has pro-competitive effects as well as anti-competitive effects. First, it promotes ex-ante competition between potential transaction partners, i.e., competition for exclusive dealing (Klein and Murphy, 2008; ICN, 2013), especially when it leads to a decrease in the price of the final good, as is the case for Costco. Second, it enables a more efficient way to make a transaction by reducing various transaction costs. Third, it facilitates investments in related products, such as

security, leading to an increase in the quality of the final good. Fourth, more innovation can be expected ex-ante for a better product both in the final good market and in the intermediate good market, as driven partially by the first effect. Fifth, relationship-specific investments are enabled so as to enhance efficiency (Che and Hausch, 1999; ICN, 2013; Abbott, 2018).[6] The second and the third effects are related to relationship-specific investments in the sense that costs may decrease and the quality may increase further when such investments are made.

On the other hand, exclusive dealing degrades the quality of competing goods (Zenger, 2010) both in the final good market and in the intermediate good market, which lessens the competitive pressure ex post. It may weaken price competition in the both markets ex post as well. Some markets can be foreclosed in the sense that competing firms may exit or the entry of potential competitors may be deterred (Bernheim and Whinston, 1998; Nurski and Verboven, 2016; Abbott, 2018; Nocke and Rey, 2018), which further lessens competition. It may also lead to less innovation in the long run (ICN, 2013). This is exactly why competition authorities are regulating exclusive dealing as a potentially anti-competitive behavior.

It is not very clear in general whether exclusive dealing is pro-competitive or anti-competitive, and its competition impact must be evaluated on a case-by-case basis (Zenger, 2010; ICN, 2013; Abbott, 2018). It is, however, usually beneficial to the coalition of the firms regardless of its competition impact.[7] Nevertheless, exclusive dealing is agreed upon in fewer occasions than is desired by the coalition, as some firms are wary of the potential for a hold-up situation. It is claimed in Klein *et al.* (1978) and Klein (1988) that relationship-specific investments which can increase the total profit of firms trading with each other are not made up to an efficient level. Relationship-specific investments have no value in trades with other firms, meaning that firms making such investments must accept less favorable terms. Hence, firms may not make such investments even when the investments are beneficial to the coalition. This does not hold only for relationship-specific investments, but also for more flexible forms of exclusive contracts.

In subcontracting transactions, cost efficiency is one of the pro-competitive effects of an exclusive contract, and is considered as the most important factor. The cost of production increases with the number of transaction partners. Such an increase in the cost may have many different causes, among them being transaction costs that subcontractors must incur when making negotiations with different partners. In addition, subcontractors may need to build and maintain additional facilities if they want to supply products to other downstream firms who may request different functions and compatibilities for their parts. If subcontractors opt to develop universal products that are compatible with many final products, doing so can also cost more per unit of production as compared to producing a single-purpose product.

In spite of such cost advantages, subcontractors do not always prefer an exclusive contract with downstream firms, as they are wary of the hold-up possibility again, as in relationship-specific investments. Subcontractors are usually in an inferior

[6]In the same context, Abbott (2018) takes an example that interbrand free riding is prevented when a gasoline dealer sells only one supplier's brand exclusively.

[7]Even when it is anti-competitive, it gives a higher level of surplus to the coalition but has a negative welfare effect on the other players that outweighs the increase in the surplus.

position when bargaining with downstream firms, and an exclusive contract may put them in an even weaker position when there are no other choices available. If their profit decreases under an exclusive contract, they will not want to enter into an exclusive contract, which consequently undermines efficiency. It would be meaningful to see when this occurs and to suggest policy interventions that restore efficient outcomes in such cases. While a theoretical analysis with an assumption on the cost function is provided in the next section, a more general perspective is discussed below.

Consider first a case in which upstream firms have a linear cost function, as in Hart and Tirole (1990). There is no hold-up problem in this case if upstream firms take the price as given,[8] as upstream firms would earn zero under non-exclusive transactions as well. Suppose instead that upstream firms have a convex cost function and that an exclusive contract shifts the cost function downward. The profit of upstream firms may then increase or decrease under an exclusive contract depending on how the cost function shifts and on how much the quantity traded increases. Figure 1 shows both possibilities when the cost is a quadratic function. Note that whether and how much the quantity traded increases depends upon the impact of exclusivity on bargaining power as well as upon production technologies and competition schemes.

While an exclusive contract can be used strategically for market foreclosure, unfair practices that fall under the Subcontracting Act have little to do with such purposes. Hence, I rule out the possibility of foreclosure by ensuring in the theoretical analysis that a downstream firm always faces competition regardless of whether it has an exclusive contract. This also shuts down upstream firms' competition for exclusive partnerships with a monopolist downstream firm as in Bernheim and Whinston (1998) and Mills (2017). Therefore, the analysis highlights the sole effect of an exclusive contract on the profits of upstream firms, free from the possibility of monopolization in the downstream market and the monopoly power of downstream firms.

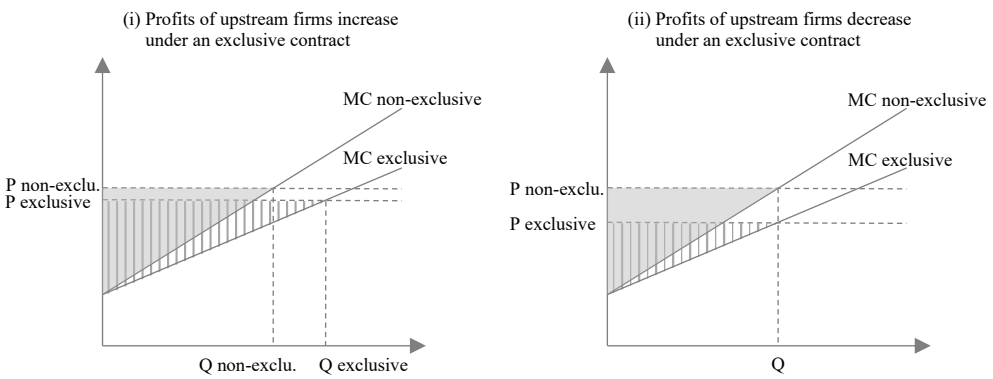

FIGURE 1. CHANGES IN THE PROFITS OF UPSTREAM FIRMS DUE TO AN EXCLUSIVE CONTRACT

[8]Hart and Tirole (1990) consider three cases, two of which assume bargaining over the gains from trade between upstream and downstream firms.

III. Theoretical Analysis

Suppose there are two downstream firms D_1 and D_2 and two upstream firms U_1 and U_2 in the supply chain. A downstream firm uses one unit of an intermediate good produced by upstream firms in order to produce one unit of a final good. Suppose further that final goods produced by the two downstream firms are identical in the sense that they are a perfect substitute for each other.[9] Assume that the demand function for the final products is given by $p = 1 - Q,$ where $Q = q_1 + q_2.$ Assume also that the cost of upstream firms is a quadratic function of their quantity, as follows[10]:

$$c(q_U) = \frac{1}{2} k q_U{}^2,$$

where k denotes the (inverse of) cost efficiency. k only depends on the exclusivity of the contract; that is, k is identical across upstream firms making the same decisions regarding exclusivity. $k = \bar{k}$ when they sell their products to all downstream firms and $k = \underline{k}$ when they make an exclusive contract with one downstream firm. $\underline{k} < \bar{k},$ meaning that exclusive contracts improve cost efficiency. Assume $\bar{k} \leq 2$ so that an equilibrium exists. For convenience purposes only, assume that the marginal cost of downstream firms is 0.

A. *Absence of an Exclusive Contract*

When there is no exclusive contract, the timing of decisions is as follows: Downstream firm *i* offers unit price u_i to upstream firms.[11] The offers are publicly known to all players. In the next stage, downstream firms compete in the final good market in a Cournot fashion. Upstream firms are profit-maximizing,[12] and downstream firms purchase only as many intermediate goods as they need to produce the final good at the unit price they offered in the previous stage.[13] There is also the assumption that upstream firms produce exactly the same amount as each other when

[9]The assumption of identical final goods is reasonable when exclusive contracts reduce transaction costs, but it may not hold when relationship-specific investments drive costs down. In the latter case, the result of this paper can be regarded as an approximation to the equilibrium in the real world. The more substitutable the final goods are, the more accurate the approximation would be.

[10]Given that this paper does not consider the possibility of foreclosure, a fixed cost does not play any role and is thus assumed to be zero.

[11]Upstream firms may offer prices in some markets, and there can be certain types of bargaining in others. It is modelled in this paper that downstream firms offer and upstream firms take it as given because the situation considered here is a subcontracting transaction where downstream firms have superior bargaining power. Chen and Riordan (2007) consider a model in which upstream firms make an offer, assuming that upstream firms have superior bargaining power. In addition, de Fontenay and Gans (2005; 2014) study a case in which all agents have some bargaining power and bargain bilaterally.

[12]This means that upstream firms supply their products as long as the unit price is no less than their marginal cost, ruling out the possibility that downstream firms force upstream firms to supply an amount that does not maximize their profits.

[13]It can be alternatively modelled such that downstream firms buy intermediate goods first and determine the quantity of the final good under capacity constraints. As one of the referees pointed out, modelling in such a way yields the same outcome under appropriate assumptions.

the demand for intermediate goods is less than their optimal level of production.

It is not straightforward to obtain the equilibrium in the model above. There are two constraints that do not exist in the standard Cournot competition model. The first is that the quantities produced by downstream firms may not exceed the quantities produced by upstream firms. Hence, downstream firms may not be able to buy as many intermediate goods as desired when they offer too low a unit price. The second constraint is that a downstream firm which offers a lower unit price will be supplied with the intermediate goods later than the other downstream firm, as upstream firms will supply their products to the latter first. This means that the former may not be able to optimally respond to the choice of the latter.

Begin with the Cournot equilibrium without these two constraints. Downstream firm i's profit function is

$$\pi_i(q_i) = (p - u_i)q_i = (1 - q_1 - q_2 - u_i)q_i.$$

Accordingly, the best response function is obtained as

$$q_i = \frac{1}{2}(1 - q_j - u_i) \quad \text{where} \quad j \neq i.$$

Therefore, the unconstrained Cournot equilibrium is

$$q_i^{uc} = \frac{1}{3}(1 - 2u_i + u_j) \quad \text{where} \quad j \neq i$$

$$p^{uc} = \frac{1}{3}(1 + u_i + u_j).$$

Coming back to the original model, there is a constraint that the quantities produced by downstream firms may not exceed the quantities produced by upstream firms. Focusing on the symmetric equilibrium that the unit price is given $u = u_1 = u_2$, each upstream firm would produce as much as

$$q_U = \frac{u}{\bar{k}}$$

because its profit function is written as

$$\pi_U(q_U) = uq_U - \frac{1}{2}\bar{k}q_U^2.$$

Therefore, upstream firms would match the demand from downstream firms as long as the demand is less than or equal to $\frac{u}{\bar{k}}$, or equivalently,

$$q_i \leq \frac{u}{\bar{k}}.$$

It is easy to see that an offer with $q_i < \frac{u}{\bar{k}}$ may not form an equilibrium, because if

this were the case, any downstream firm will be better off by lowering u by a small amount, which increases its quantity and decreases its cost without increasing the possibility that it may not be able to be supplied less than desired. Indeed, $q_i = \frac{u}{\bar{k}}$ holds at the equilibrium; thus,

$$u_1^* = u_2^* = \frac{\bar{k}}{\bar{k}+3}$$

$$q_1^* = q_2^* = \frac{1}{\bar{k}+3}$$

$$p^* = \frac{\bar{k}+1}{\bar{k}+3}.$$

Of course, it is still necessary to show that there is no equilibrium with $q_i > \frac{u}{\bar{k}}$ for some *i* and that there is no asymmetric equilibrium. This leads to the following lemma:

Lemma 1. Assume $\bar{k} \le 2$. When upstream firms do not make an exclusive contract with any downstream firm, the unique equilibrium offers made by downstream firms can be expressed as follows:

$$u_1 = u_2 = u^* \equiv \frac{\bar{k}}{\bar{k}+3},$$

and the Cournot equilibrium in the final product market is

$$q_1 = q_2 = q^* \equiv \frac{1}{\bar{k}+3}$$

$$p^* \equiv \frac{\bar{k}+1}{\bar{k}+3}.$$

Proof. See Appendix.

B. *Under Exclusive Contracts*

Now consider the case in which each of upstream firms make an exclusive contract with one downstream firm. Due to exclusivity of the contract, upstream firms may not sell their intermediate products to the other downstream firm offering a higher unit price. Therefore, downstream firms would not take into account the possibility that their rival's offer affects their capacity constraint when they make an offer to the subcontractor with which they exclusively trade. Because their subcontracting upstream firm would supply q_i as long as $q_i \le \frac{u_i}{\underline{k}}$, downstream firms cannot produce

q_i when offering $u_i < \underline{k}q_i$ but have no reason to offer $u_i > \underline{k}q_i$. Hence, $q_i = \frac{u_i}{\underline{k}}$ holds. The offers are publicly known to all players. The profit of downstream firms can now be written as a function of u_i only:

$$\pi_i(u_i) = (p - u_i)q_i(u_i) = \left(1 - \frac{u_i}{\underline{k}} - \frac{u_j}{\underline{k}} - u_i\right)\frac{u_i}{\underline{k}}, \quad \text{where} \quad j \neq i.$$

Solving the first-order conditions of downstream firms yields

$$u_1^{**} = u_2^{**} = \frac{\underline{k}}{2\underline{k}+3},$$

which is different from the equilibrium offers when upstream firms may sell their products to any downstream firm. This gives the following lemma:

Lemma 2. When upstream firms make an exclusive contract with one downstream firm each, the equilibrium offers made by downstream firms are

$$u_1 = u_2 = u^{**} \equiv \frac{\underline{k}}{2\underline{k}+3}$$

and the corresponding Cournot equilibrium in the final product market is

$$q_1 = q_2 = q^{**} \equiv \frac{1}{2\underline{k}+3}$$

$$p^{**} = \frac{2\underline{k}+1}{2\underline{k}+3}.$$

It is easy to see that u_i is always lower under exclusivity, or equivalently $u^{**} < u^*$. Note first that $\frac{\overline{k}}{2\overline{k}+3} < \frac{\overline{k}}{\overline{k}+3}$. Given that $\frac{k}{2k+3}$ is increasing in k, and $\underline{k} < \overline{k}$, it follows that $u^{**} < u^*$. On the other hand, q_i may be larger or smaller under exclusivity depending on how much cost efficiency will be improved by an exclusive contract. $q^{**} > q^*$ when $\underline{k} < \frac{1}{2}\overline{k}$, and $q^{**} \leq q^*$ otherwise. p moves exactly in the opposite direction.

The central reason that the equilibrium offers and quantities are different from those under non-exclusive trades is that downstream firms who want to produce more must increase u_i in proportion to q_i under an exclusive contract. In contrast, when they buy intermediate goods non-exclusively, offering u_i slightly higher (than

u_j) enables them to increase q_i by much more than the amount u_i increased.[14] Therefore, when a trade occurs at the exclusivity equilibrium quantities (as in Lemma 2) under non-exclusive relationships, downstream firms have an incentive to deviate by increasing their quantities.

The most interesting question is whether upstream firms would have an incentive to make an exclusive contract with downstream firms. The equilibrium profit of upstream firms under each condition can be written as follows:

$$\pi_U^* = u^* q^* - \frac{1}{2}\bar{k}q^{*2} = \frac{\bar{k}}{2\left(\bar{k}+3\right)^2}$$

$$\pi_U^{**} = u^{**} q^{**} - \frac{1}{2}\underline{k}q^{**2} = \frac{\underline{k}}{2\left(2\underline{k}+3\right)^2}$$

As noted earlier, u_i is lower under exclusivity. However, the cost is also lower as $\underline{k} < \bar{k}$, so one may guess that upstream firms would be better off under certain conditions. The following proposition shows that such a condition does not exist.

Proposition 1. Suppose that upstream firms have a cost function of $c(q) = \frac{1}{2}\underline{k}q^2$ under an exclusive contract and that its cost is $c(q) = \frac{1}{2}\bar{k}q^2$ under non-exclusivity with $\underline{k} < \bar{k} \leq 2$. Upstream firms are strictly worse off when they enter into an exclusive contract.

Proof. See Appendix.

The proposition above has the following implications. An exclusive contract may enhance efficiency by reducing costs as well as inducing innovation, but some trading partners may not prefer an exclusive contract to non-exclusive trades. Specifically in this model, an exclusive contract reduces production costs (as well as transaction costs that are increasing in quantity), but no upstream firm wants to make an exclusive contract. It can be easily checked that there are some conditions under which social welfare is greater under an exclusive contract than under non-exclusivity; therefore, it follows that a socially more desirable exclusive contract may be avoided by upstream firms.[15]

Upstream firms prefer non-exclusive trades because they must accept unfavorable terms and conditions under an exclusive contract. When they have an outside option,

[14]The total supply of intermediate goods may not increase when the incentive constraints of upstream firms are binding. For example, suppose $\bar{k} = 1$ and both downstream firms produce $q_1 = q_2 = 0.2$ with $u_1 = u_2 = 0.2$. In this case, upstream firms have no incentive to produce more than 0.2 each; thus, even if one downstream firm wants to buy more, the total supply of intermediate goods would be fixed at 0.4. However, a downstream firm can buy more by offering an infinitesimally higher u_i, resulting in the other firm buying less.

[15]This statement is implied by Proposition 1, which entirely depends on the specification of the model, but shows that efficiency may not be achieved under some circumstances.

they have some bargaining power against downstream firms even though downstream firms make an offer on the unit price. They may supply their products first to a downstream firm who offers the highest unit price and then to one who offers the second highest, and so on, which prevents downstream firms from offering too low a unit price. However, when they exclusively trade with one firm, they have no other choice but to accept that firm's offer. This gives downstream firms more bargaining power compared to that under non-exclusivity.

C. *Offering Incentives for Exclusivity*

Downstream firms would voluntarily attempt to incentivize upstream firms to engage in an exclusive contract. One way is to offer a higher unit price so that upstream firms can earn as much profit as they earn when they do not make an exclusive contract.

Consider a one-period game in which downstream firms offer a unit price for exclusive intermediate goods that they will commit to, and then upstream firms sequentially decide whether to make an exclusive contract with one downstream firm.[16] To avoid coordination failures, suppose that upstream firm 1 (U_1) decides first and U_2 decides second and that when U_1 chooses not to make an exclusive contract but U_2 chooses to do so, U_1 has another chance to make a decision. If no exclusive contract is made, downstream firms offer a unit price for non-exclusive intermediate goods, in which case the equilibrium forms as in Lemma 1. If only one exclusive contract is made, a downstream firm who fails to make an exclusive contract offers a unit price for non-exclusive intermediate goods, which can be supplied only by an upstream firm who also fails to make an exclusive contract. In the final stage of the game, downstream firms engage in Cournot-style competition in the final product market. The timing of the decision can be summarized as follows:

(stage 1) D_1 and D_2 make corresponding offers u_1 and u_2 for an exclusive contract.
(stage 2) U_1 chooses to make an exclusive contract with D_1 or D_2, or none.
(stage 3) U_2 chooses among downstream firms left uncontracted, or none.
(stage 3-1) If U_1 chooses none and U_2 chooses one, U_1 has another chance to choose.
(stage 4) Uncontracted downstream firms offer a unit price for non-exclusivity.
(stage 5) Downstream firms compete a la Cournot in the final goods market. Intermediate goods are purchased and final goods are produced.

The following lemma shows the subgame perfect equilibrium of the above game.

[16]The same result ensues, differing only in the equilibrium payoffs, when assuming that upstream firms decide simultaneously, which means that the result in this paper is robust to choice of the model.

Lemma 3. Offering $u_1 = u_2 = u^{***}$ constitutes a symmetric subgame perfect equilibrium of the game offering a committed unit price for exclusive intermediate goods, where u^{***} is the smallest value that satisfies the following inequality:

$$\frac{u^{***}\left(1-u^{***}\right)}{3} - \frac{1}{2}\underline{k}\left(\frac{1-u^{***}}{3}\right)^2 \geq \frac{\overline{k}}{2\left(\overline{k}+3\right)^2}$$

Proof. See Appendix.

The lemma above shows that there exists a unit price that makes upstream firms under an exclusive contract as well off as when they do not make an exclusive contract. This leads to the following proposition:

Proposition 2. Suppose that downstream firms offer a unit price for exclusive intermediate goods that they will commit to, with upstream firms then sequentially deciding whether to make an exclusive contract with one of the downstream firms. There always exists an equilibrium where an exclusive contract is made and upstream firms are as well off as under non-exclusive trades.

Proof. See Appendix.

The proposition above demonstrates how downstream firms can incentivize upstream firms to engage in an exclusive contract so that more efficient ways of production and/or transactions can be utilized. Under this equilibrium, upstream firms are apparently better off than when they do not have any choice but to make an exclusive contract (as in Lemma 2). It is easy to check that downstream firms are also better off. The equilibrium quantities in the final product market may be larger or smaller depending on $\overline{k}$ and $\underline{k}$, and the social welfare may also correspondingly be higher and lower.[17]

What seems unclear is whether social welfare is higher at the equilibrium where upstream firms willingly engage in an exclusive contract (as in Lemma 3) compared to that where upstream firms do not choose exclusivity (as in Lemma 1). It is clear that upstream firms earn the same profit because downstream firms choose such a unit price and that downstream firms make more profits. In fact, the equilibrium quantities are larger and the equilibrium price is lower, as is shown by the following lemma. Accordingly, social welfare is also higher.

[17]Equilibrium quantities are usually larger under the equilibrium of Lemma 3 compared to that of Lemma 2, but it could be the other way around when $\underline{k}$ is very close to 0, in which case q^{**} is very close to $\frac{1}{3}$ but $q^{***} = \frac{1-u^{***}}{3}$ (see the proof of Lemma 3) is clearly smaller than $\frac{1}{3}$, as u^{***} is bounded away from 0 by the condition of Lemma 3.

Lemma 4. The equilibria under the conditions in Lemmas 1 and 3 are compared to each other as follows:

$$u^{**} < u^{***} < u^{*}, q^{*} < q^{***}, \text{and } p^{***} < p^{*}$$

Proof. See Appendix.

This implies the following proposition.

Proposition 3. Social welfare is higher at the symmetric equilibrium, where downstream firms incentivize upstream firms to engage in an exclusive contract compared to that where firms do not make an exclusive contract.

The problem is that such a voluntary exclusive contract may not appear when trading continues for multiple periods. If firms can successfully enter into a long-term contract, downstream firms can incentivize upstream firms to engage in an exclusive contract by committing to a higher unit price for every period. What would happen, however, if there are certain practical difficulties that arise when making a long-term contract? The following proposition presents a pessimistic outcome.

Proposition 4. Suppose that the unit price offered by downstream firms can be committed to only for the first period and that upstream firms are prevented from returning to non-exclusive products once they choose to produce exclusive ones. If upstream firms supply their products for T periods, there always exist a discount rate $\beta < 1$ and T for which upstream firms do not make an exclusive contract as long as $\underline{k} > 0$.

Proof. When an upstream firm does not choose exclusivity, its profit will be π_U^* for T periods. When an exclusive contract is made, let π_U^{1st} denote the first period profit guaranteed to the upstream firm. As downstream firms will enforce $u_1 = u_2 = u^{**}$ from the second period on, the profit of the upstream firm will be

$$\pi_U^{1st} + \sum_{t=2}^{T} \beta^{t-1} \pi_U^{**} = \pi_U^{1st} + \sum_{t=2}^{T} \beta^{t-1} \frac{\underline{k}}{2\left(2\underline{k}+3\right)^2} .$$

π_U^{1st} cannot be greater than $\frac{1}{2\left(\underline{k}+6\right)}$ given that $qu - \frac{1}{2}\underline{k}q^2$ is maximized when $u = \frac{\underline{k}+3}{\underline{k}+6}$ and $q = \frac{1-u}{3} < \frac{u}{\underline{k}}$, yielding $\pi_u^{1st} = \frac{1}{2\left(\underline{k}+6\right)}$. To incentivize upstream firms, it must be

$$\pi_U^{1st} + \sum_{t=2}^{T} \beta^{t-1} \pi_U^{**} \geq \sum_{t=1}^{T} \beta^{t-1} \pi_U^{*}$$

or equivalently,

$$\pi_U^{1st} - \pi_U^* \geq \sum_{t=2}^{T} \beta^{t-1} \left(\pi_U^* - \pi_U^{**} \right).$$

As β goes to 1 and T goes to infinity, the above condition does not hold because $\pi_U^* - \pi_U^{**} > 0$ when $\bar{k} > 0$. **Q.E.D.**

The proposition above means that in most cases, downstream firms may fail to incentivize upstream firms to engage in an exclusive contract. For example, when $\bar{k} = 2$ and $\underline{k} = 1$, upstream firms do not want exclusivity, even at the values as low as $\beta = 0.9$ and $T = 3$. When $\bar{k} = 0.1$ and $\underline{k} = 0$, an exclusive contract is not preferred at $\beta = 0.99$ and $T = 18$ as well as at $\beta = 0.95$ and $T = 32$.

It is important to discuss the assumptions in Proposition 4. One may wonder about the validity of the assumption that downstream firms can commit to the unit price only for the first period. It is not impossible for them to commit for longer periods by making a long-term contract. However, a long-term contract has its own vulnerability in that when market circumstances change rather quickly, a competing firm not subject to a long-term contract may aggressively lower its price and thus capture the market.[18] Uncertainties regarding market conditions are translated into incompleteness of the contract in the literature, and it is often assumed that no long-run commitment is possible. For example, Tirole (1986) assumes that the parties cannot constrain future negotiations, explaining why it is a valid assumption. He also points out that price fixing for a long term is in general inefficient ex post and thus subject to renegotiation. Hence, downstream firms may not want to commit for an overly long term, in which case Proposition 4 can have implications pertaining to the feasibility of an exclusive contract.

One may think it is too restrictive to assume that upstream firms may not return to non-exclusive products once they choose to produce exclusive ones. If they choose to end an exclusive contract, however, there is much to lose. They may already have made relationship-specific investments on a large scale to produce exclusive intermediate goods efficiently, in which case they need to incur sunk costs in order to end the relationship. Such investments include not only production facilities but also intangible assets such as the learning of tacit knowledge specific to the relationship, and the building of a friendly relationship. They must incur more transaction costs to build new trade partnerships with other buyers. Therefore, it is not impossible to return to non-exclusivity but it may be very costly to do so.

IV. Policy Implications

A. *Regulation and Efficiency*

The analysis in the previous section implies that an exclusive contract can be

[18]This does not apply only to downstream firms but also to upstream firms. Upstream firms may want to raise the unit price when the price of raw materials increases, but it would be more difficult to do so under a long-term contract.

avoided by firms with lower bargaining power even when exclusivity reduces costs. The rationale behind this is the contention that an exclusive contract is subject to hold-up problems. Parties in an inferior position with regard to transactions, who are upstream firms in a subcontracting context, may have to accept less favorable terms and conditions under exclusivity than under non-exclusive trades, as they can no longer switch to a different transaction partner. In the model, upstream firms who choose an exclusive contract must accept a lower unit price and earn less profit.

This hold-up problem can be overcome through commitments by firms with higher bargaining power. In the model, downstream firms can guarantee upstream firms a higher unit price to make an exclusive contract, yielding higher social surplus. But what if the commitment does not last long? Downstream firms may fail to incentivize upstream firms when the contract lasts for a longer time without commitment to the higher unit price. Many firms are reluctant to be tied up by an inflexible long-term contract,[19] meaning that an exclusive contract may not be entered into even when it is more efficient.

Limiting abuse of a superior position in transactions may enhance efficiency in this context. If downstream firms are prevented from cutting a unit price from the initial level, upstream firms would have the incentive to enter into an exclusive contract, as the commitment for the first period is extended by the regulation to later periods. Hence, downstream firms can enjoy an increase in efficiency from the exclusive contract, which includes a production cost reduction, reduced transaction costs, and so on. The total quantity is also increased and the price is reduced, resulting in higher social surplus.

Such an intervention, however, should not be a strict and inflexible regulation. An inflexible regulation has the same effect as a voluntary long-term commitment, which would have been made if beneficial to the transacting parties on both sides. There is a good reason for a commitment to be agreed upon only over the short term. Market conditions can change quickly due to competition and innovation and due to business cycles and non-economic shocks. Downstream firms would not want to bear sunk costs that are too high in order to flexibly respond to changes in market conditions, and neither would upstream firms.

Therefore, the regulation must be designed to make reasonable hurdles for downstream firms with regard to cutting unit prices. More specifically, downstream firms may cut a unit price only if they can justify the reason to do so. For example, a price cut would be justified if it boosts demand for the final product by lowering its price, and as a result, leads to larger sales and greater joint profits in the end. A price cut would also be reasonable if competitors have already gained price competitiveness by responding to decreases in the prices of raw materials for intermediate goods. A price cut is unavoidable if the firm would have to shut down its facilities and exit the market without it.

There is a difference between allowing a price cut only for a justifiable reason and prohibiting an undue price cut. From a legal perspective, the former prohibits a price cut in principle but allows a cut when downstream firms can justify it. In other words, the burden of proof is levied on the firms who practice the behavior. In contrast, the

[19]Abbott (2018) states that "Long-term, flexible contracts can minimize costs and risks to both parties of dealing with future uncertainties."

latter case allows a price cut unless the government proves it undue. Under this regime, a price cut may not be illegal if its magnitude is too small to have an impact on upstream firms. In this sense, the latter is more lenient towards downstream firms than the former. Considering the effects on the efficiency of the outcome, price cuts must be prohibited in principle so that upstream firms are encouraged to enter into an exclusive contract and increase their efficiency without fear of the hold-up problem.

In order to highlight the usefulness of this policy, it is helpful to discuss other policies to reduce bargaining power differences. There are some policies to boost the bargaining power of subcontractors. One way is industrial policies to raise the technical level of subcontractors.[20] This method is most desirable in the sense that it benefits both subcontractors and downstream firms and, consequently, the industry and the national economy. However, R&D cannot be successful for all firms, meaning that the effects of the policies would be limited to a small number of firms.

Another way is promotion policies to diversify transaction partners. It is unusual for a subcontractor to sell its products to many downstream firms in sectors where subcontracting prevails.[21] If a subcontractor can trade with more downstream firms, its relative bargaining power will increase. There are, however, certain practical barriers and an efficiency problem. First, there are relatively a small number of downstream firms compared to upstream firms in such sectors, meaning that it is not easy to find another downstream firm to transact with, as there are many subcontractors already working with such firms.[22] Hence, it is recommended that subcontractors export their products. As this is also challenging, there are relatively few firms who have been successful in diversifying their transaction partners.

The greatest weakness of the policy to diversify transaction partners is the efficiency problem. Such a policy reduces differences in bargaining power but raises costs, as the cost increases with the number of transaction partners, as was discussed in Section 2. If a policy increases the profit of some parties but undermines efficiency, it would not be regarded as a desirable policy.[23] Such a policy would be dominated by policies that incentivize subcontractors to stay in an efficient exclusive contract, which is to limit the abuse of a superior position by a downstream firm.

To summarize, the diversification policy is relatively less useful, and the R&D policy has a limited impact in terms of the scope of the potential beneficiaries due to difficulties and uncertainties related to R&D, although success in R&D produces the most desirable outcome. Therefore, the government must not only induce subcontractors to invest in R&D and raise their technical level, but it also has a reason to regulate bargaining power abuses by downstream firms in order to reduce bargaining power differences.

[20]For example, ASML possesses a high bargaining power over Samsung, TSMC, and Intel.

[21]There are several causes of this phenomenon, and one of them is that the government induced such a structure in the mid-1970s, as it was thought to be an efficient means of manufacturing. The introduction of the "Promoting Vertical Structure of SME Act" in 1975 was one of the related policies.

[22]This is why SMEs attempt to sell their products to overseas companies.

[23]Guaranteeing the profits of SMEs may have its own dynamic efficiency effect in the sense that doing so would help SMEs grow and thus cause the economy to become more dynamic. However, it would more desirable if a policy also preserves other efficiencies at the same time.

B. *Issues in Implementation*

Abuses of a superior position are regulated by the Subcontracting Act. More specifically, there are 24 clauses[24] in the Act which penalize unfair subcontracting behaviors. Among them, Article 4 regulates undue price setting behaviors. Item 1 of Article 4 states that downstream firms (outsourcing firms) should not set subcontracting prices at a level lower than the usual price paid for the same or similar products. Item 2 specifies certain behaviors that are deemed to be undue price setting. For example, it is illegal to cut a unit price by a uniform rate without justification. It is also illegal to discriminate some subcontractors in price setting from others without justification.

The spirit of Article 4 is broadly consistent with the implications of the theoretical analysis in the previous section. The Article prevents downstream firms from cutting prices but allows some types of price cutting in justifiable cases. However, it is not consistent with the theoretical implications in some aspects. I discuss three such points in more details below.

First, Article 4 uniformly applies to all subcontractors, including non-exclusive ones. The theoretical analysis shows that exclusivity lowers the bargaining power of upstream firms further, making them accept less favorable terms and conditions and earn less profit. Hence, it would be more reasonable to protect exclusive subcontractors from broader ranges of price-cutting behaviors. This means that some price-cutting behaviors do not have to be prevented if they are conducted against non-exclusive subcontractors. In principle, non-exclusive subcontractors are free to choose transaction partners and thus have no reason to accept an undue price offer. A practical problem is that only a small number of subcontractors are free to choose their transaction partners. In most cases, subcontractors have trouble finding different transaction partners despite the fact that they may trade with more than one downstream firm. In this sense, many subcontractors have an exclusivity constraint to some extent, even if not entirely. Therefore, Article 4 must be applied differently to subcontractors depending on the extent of the exclusivity of their transactions.

Second, some types of price-cutting behaviors are not regulated even though regulating such behaviors against exclusive subcontractors enhances efficiency. While Item 2-1 of Article 4 bans a unit price reduction at a uniform rate, there is no other statement that prohibits any price cut from the initial level. This means that downstream firms may cut prices at a non-uniform rate. The possibility of such behavior may discourage subcontractors from entering into an exclusive contract and realizing efficient outcomes, according to the theoretical analysis in the previous section. Hence, it would be more desirable to prohibit any price cut from the initial level without justification if the trade is entirely exclusive on the subcontractor's side.

Third, price discrimination does not have to be regulated if price cuts are prohibited in principle. Item 1 bans setting prices lower than usual, and Item 2-3 prohibits price discrimination between subcontractors. But, there is little evidence that price discrimination undermines efficiency.[25] One possibility is that some

[24]Unfair subcontracting behaviors that violate Articles 3, 3-4, 3-5, 4, 5, 6, 7, 8, 9, 10, 11, 12, 12-2, 12-3, 13, 13-2, 13-3, 14, 15, 16, 16-2, 17, 18, and 20 are subject to fine. Violation of other clauses including Articles 19 and 25 is also penalized, but they have nothing to do with subcontracting behaviors.

[25]When an upstream firm has superior bargaining power and discriminates between downstream firms in terms

promising subcontractors reduce their R&D expenditures if they expect that they will be offered a lower price than their competitors after successfully reducing costs. Nonetheless, this does not occur if downstream firms are banned from lowering prices from the initial level, as suggested above. The same reasoning applies to other possibilities as well. It is difficult to think of a case in which efficient outcomes are deterred by price discrimination when downstream firms are prohibited from lowering prices from the initial level without justifiable reasons.

V. Concluding Remarks

This paper shows that it can enhance efficiencies to limit the abuse of superior bargaining power by downstream firms in subcontracting trades. Such a regulation encourages upstream firms to engage in an efficient exclusive contract, which reduces production costs as well as transaction costs. When upstream firms are incentivized to enter into such an exclusive contract, social welfare increases as total production increases, equilibrium prices decrease, and costs shift downward compared to the case in which upstream firms trade with downstream firms in a non-exclusive relationship.

The result does not mean that regulations always increase efficiency, however. First, an inflexible regulation is effectively identical to compelling a long-term commitment which would have been voluntarily made if it would produce efficient outcomes. Thus, the regulation must be applied with some flexibility, allowing exceptions when justified. Second, the result applies only to cases in which downstream firms have superior bargaining power and an exclusive contract further expands the gap in bargaining power. The regulation would have a different effect when upstream firms have some bargaining power against the downstream firm or when upstream firms trade with the downstream firm in a less exclusive relationship. Third, the result depends on the production technologies. The theoretical analysis assumes that the cost function of upstream firms takes a quadratic form. It can be extended to a more general set of production technologies that exhibit a decreasing return to scale, but not to those representing a constant return to scale or an increasing return to scale. All of these limitations must be considered when enforcing the regulation.

The analysis in this paper focuses on unfair pricing behaviors. The Subcontracting Act prohibits other types of unfair subcontracting behaviors as well. For example, behaviors that are in contrast with the terms of a contract or that fail the duty of good faith are prohibited. These include unreasonable cancellations of contracts (Article 8), failures to report inspection results (Article 9), unreasonable returns of products (Article 10), failures to make payments (Article 13), failures to pay tax refunds (Article 15), and unexpected in-kind payments (Article 17). Behaviors that make unreasonable requests to subcontractors are prohibited as well. These behaviors may also discourage upstream firms from entering into an exclusive contract by an analogous logic, meaning that it may improve efficiency to regulate them. However, there are also

of prices, competition in the final product market may be distorted. However, even in such a situation, it is not obvious that competition is distorted, meaning that price discrimination should not be prohibited per se but should be regulated on a rule-of-reason basis.

paternalistic regulations unrelated to efficiency, such as Article 6 which specifies how timely and in what size payments must be made. These regulations must be evaluated and enforced under different criteria, such as inclusive growth.

This paper makes a clear contribution to the literature in that it suggests a better regulation to encourage firms to enter into exclusive contracts when doing so is efficient. Hart and Tirole (1990) analyze firms' incentives for vertical integration, which has effects similar to those of an exclusive contract, but they do not consider the possibility that vertical integration reduces production costs, instead focusing on anti-competitive effects. They find a condition under which vertical integration occurs and show that it forecloses competitors from the market and thus results in lower social surplus. Bernheim and Whinston (1998) examine firms' incentives to engage in exclusive dealing when it may increase efficiency, but they also focus on its foreclosure effects. They find a condition under which exclusive dealing occurs and show that it leads to welfare losses but that banning it does not always increase social welfare.

Not analyzed in this paper is whether unfair pricing behaviors by downstream firms reduce investments by subcontractors. This issue has been examined in many studies of contract theory, such as Tirole (1986) and Che and Hausch (1999), for example. Incorporating such an investment incentive into the model may augment the efficiency enhancing effect of the regulation to limit abuse of superior bargaining power by downstream firms. On the other hand, downstream firms may also make investments in relationship-specific assets, in which case the regulation would have an ambiguous effect on the joint surplus. Moreover, such investments may be made through a voluntary agreement between downstream firms and subcontractors. It requires a more sophisticated analysis to incorporate such incentives into the model.

APPENDIX

Proofs

Proof of Lemma 1.

By backward induction, let us find the optimal production of upstream firms when D_1 and D_2 demand q_1 and q_2, respectively. Let $u_2 \le u_1 < 1$ without loss of generality. Then, upstream firms supply their intermediate goods to D_1 first and D_2 next. When they produce a very low amount q_U, they sell only to D_1 at u_1, meaning that their profit will be $u_1 q_U - \frac{1}{2}\bar{k}q_U^2$. When they produce more than q_1, they sell q_1 to D_1 at u_1 and the rest to D_2 at u_2. Accordingly, the profit would be $u_1 \cdot \frac{1}{2}q_1 + u_2\left(q_U - \frac{1}{2}q_1\right) - \frac{1}{2}\bar{k}q_U^2$ if upstream firms split the demand equally. As it is assumed that upstream firms produce amounts identical to each other when the demand for intermediate goods is less than their optimal level of production, the profit function of each upstream firm with q_1, q_2, u_1 and u_2 given is

$$\pi_U(q_U) = \begin{cases} u_1 q_U - \frac{1}{2}\bar{k}q_U^2 & \text{if } q_U \le \frac{1}{2}q_1 \\ u_2 q_U - \frac{1}{2}\bar{k}q_U^2 + (u_1 - u_2)\cdot\frac{1}{2}q_1 & \text{if } \frac{1}{2}q_1 < q_U \le \frac{1}{2}(q_1 + q_2) \end{cases}.$$

Hence, their optimal production is

$$q_U(q_1, q_2, u_1, u_2 \mid u_2 \le u_1) = \begin{cases} \min\left(\frac{1}{2}q_1, \frac{u_1}{\bar{k}}\right) & \text{if } u_2 \le \bar{k}\cdot\frac{1}{2}q_1 \\ \min\left(\frac{1}{2}q_1 + \frac{1}{2}q_2, \frac{u_2}{\bar{k}}\right) & \text{if } u_2 > \bar{k}\cdot\frac{1}{2}q_1 \end{cases},$$

which means that when u_2 is very low, upstream firms supply only to D_1, but when u_2 is high enough, they supply to D_2 as well.

Let us find first the equilibrium output when u_2 is very high so upstream firms produce all of the quantities demanded, that is, when $\frac{1}{2}q_1 + \frac{1}{2}q_2 \le \frac{u_2}{\bar{k}}$. In this case, downstream firms produce an unconstrained Cournot equilibrium output $q_i^{uc} = \frac{1}{3}(1 - 2u_i + u_j)$ where $j \ne i$. First, $\frac{1}{2}q_1 + \frac{1}{2}q_2 < \frac{u_2}{\bar{k}}$ cannot be an equilibrium condition, as if so, D_2 can profitably lower u_2. Second, $u_1 > u_2$ cannot be an equilibrium condition, as if so, lowering u_1 raises q_1, leaving the total quantity

$q_1+q_2=\frac{2u_2}{\bar{k}}$ and the price unchanged, and thus gives more profit to D_1. Then, the only possibility is that $q_1=q_2=\frac{u_1}{\bar{k}}=\frac{u_2}{\bar{k}}$ holds. Solving this with the Cournot equilibrium output condition yields $u_1^*=u_2^*=\frac{\bar{k}}{\bar{k}+3}$ and $q_1^*=q_2^*=\frac{1}{\bar{k}+3}$, $p^*=\frac{\bar{k}+1}{\bar{k}+3}$.

To show that no one wants to deviate, suppose D_1 raises u_1 such that $\frac{\bar{k}}{\bar{k}+3}=u_2^*<u_1^d$. The unconstrained Cournot equilibrium is $q_1^{uc}=\frac{1-2u_1^d+u_2^*}{3}$ and $q_2^{uc}=\frac{1+u_1^d-2u_2^*}{3}$, which is feasible given that $\frac{1}{2}q_1^{uc}+\frac{1}{2}q_2^{uc}<\frac{u_2^*}{\bar{k}}=\frac{1}{\bar{k}+3}$. D_1 now earns $\pi_1^d=\frac{\left(1-2u_1^d+u_2^*\right)^2}{9}<\frac{\left(1-u_2^*\right)^2}{9}=\pi_1^*$ and as such D_1 has no incentive to raise u_1. If D_2 lowers u_2 so that $u_2^d<u_1^*=\frac{\bar{k}}{\bar{k}+3}$, upstream firms produce $\frac{u_2^d}{\bar{k}}$ each and supply D_1 first and D_2 with the rest, leading to $q_2=\frac{2u_2^d}{\bar{k}}-q_1$. Given u_1^* and u_2^d, D_1's best response function is $q_1=\frac{1-q_2-u_1^*}{2}$, which leads to the constrained Cournot equilibrium $q_1^c=1-\frac{2u_2^d}{\bar{k}}-u_1^*$ and $q_2^c=-1+\frac{4u_2^d}{\bar{k}}+u_1^*$ when $\bar{k}\cdot\frac{1}{2}q_1^c<u_2^d\le u_1^*$. D_2's profit is then

$$\pi_2^d\left(u_1^*,u_2^d\right)=\left(1-q_1-q_2-u_2^d\right)q_2=\left(1-\frac{2u_2^d}{\bar{k}}-u_2^d\right)\left(-1+\frac{4u_2^d}{\bar{k}}+u_1^*\right)$$

and thus its marginal profit at $u_2=u_2^*$ is

$$\frac{d\pi_2\left(u_1^*,u_2^*\right)}{du_2}=\left(-\frac{2}{\bar{k}}-1\right)\left(-1+\frac{4u_2^*}{\bar{k}}+u_1^*\right)+\left(1-\frac{2u_2^*}{\bar{k}}-u_2^*\right)\cdot\frac{4}{\bar{k}}=\frac{2-\bar{k}}{\bar{k}\left(\bar{k}+3\right)},$$

which is non-negative as $\bar{k}\le 2$. Therefore, D_2 has no incentive to lower u_2, which confirms that $u_1^*=u_2^*=\frac{\bar{k}}{\bar{k}+3}$ and $q_1^*=q_2^*=\frac{1}{\bar{k}+3}$ form an equilibrium.

Next, let us search for an equilibrium in which upstream firms produce less than the quantities demanded. It is clear that there is no equilibrium in which D_2 produces nothing, as it can deviate to earn a positive profit by offering some $u_2<p$. The only possibility is that D_2 offers u_2 such that $\bar{k}\cdot\frac{1}{2}q_1<u_2\le u_1$ and produces a positive

amount. $u_2 < u_1$ cannot be an equilibrium condition, as if so, D_1 can profitably lower u_1. To see this, recall that the constrained Cournot equilibrium is $q_1^c = 1 - \frac{2u_2}{\bar{k}} - u_1$ and $q_2^c = -1 + \frac{4u_2}{\bar{k}} + u_1$ when $\bar{k} \cdot \frac{1}{2} q_1 < u_2 < u_1$. D_1's profit is then $\pi_1 = \left(1 - \frac{2u_2}{\bar{k}} - u_1\right)^2$, meaning that D_1 can earn more by lowering u_1 towards u_2. However, if $u_1 = u_2$ and upstream firms have an incentive to produce more than the quantities demanded, either D_1 or D_2 has an incentive to offer a higher unit price. To see this, note first that D_1 wants to be supplied $1 - \frac{2u_2}{\bar{k}} - u_1$ when $u_2 \le u_1$. Suppose $u_1 = u_2$ and D_1 is supplied less than the corresponding demand; that is, $q_1 < 1 - \frac{2u_2}{\bar{k}} - u_1$. In such a case, its profit is

$$\underline{\pi_1} = (p - u_1) q_1 = \left(1 - \frac{2u_2}{\bar{k}} - u_1\right) q_1 < \left(1 - \frac{2u_2}{\bar{k}} - u_1\right)^2 = \left(1 - \frac{2u_2}{\bar{k}} - u_2\right)^2.$$

D_1 can find ε such that offering $u_1^d = u_2 + \varepsilon > u_2$ gives

$$\pi_1^\varepsilon = \left(1 - \frac{2u_2}{\bar{k}} - u_1^d\right)^2 = \left(1 - \frac{2u_2}{\bar{k}} - u_2 - \varepsilon\right)^2 > \underline{\pi_1}.$$

Suppose $u_1 = u_2$ and D_1 is supplied as a priority, in contrast. In this case, D_2 has an incentive to offer a higher u_2 likewise. Therefore, there is no equilibrium in which upstream firms produce less than the quantities demanded, and the unique equilibrium is $u_1^* = u_2^* = \frac{\bar{k}}{\bar{k} + 3}$. **Q.E.D.**

Proof of Proposition 1.

It follows from Lemmas 1 and 2 that

$$\pi_U^{**} - \pi_U^* = \frac{\underline{k}}{2(2\underline{k} + 3)^2} - \frac{\bar{k}}{2(\bar{k} + 3)^2} = \left[\frac{\underline{k}}{2(2\underline{k} + 3)^2} - \frac{\underline{k}}{2(\underline{k} + 3)^2}\right] + \left[\frac{\underline{k}}{2(\underline{k} + 3)^2} - \frac{\bar{k}}{2(\bar{k} + 3)^2}\right].$$

The first component of the right-hand side is always non-positive for $\underline{k} \ge 0$, and the second component is always negative for $\underline{k} < \bar{k} \le 2$ given that

$$\frac{d}{dk}\left[\frac{k}{2(k+3)^2}\right] = \frac{3 - k}{2(k+3)^3} > 0$$

for $k < 3$. **Q.E.D.**

Proof of Lemma 3.

Note first that when U_1 chooses an exclusive contract with a downstream firm, U_2 has no reason to reject an exclusive contract with the other downstream firm, as there is no other downstream firm to transact with, so rejecting exclusivity does not change its bargaining position but only prevents it from lowering its marginal cost. When one of the offers u_1 and u_2 is attractive enough, U_1 will make an exclusive contract, and so will U_2. When none of the offers is attractive, U_1 will choose non-exclusivity because it believes U_2 will do so. This occurs because when U_1 chooses none in stage 2, U_2 faces the same offers in stage 3 previously presented to U_1. Hence, U_2 makes the same decision that U_1 made. Note that stage 3-1 ensures that U_2 makes the same decision with U_1, as if U_1 has no chance to reconsider, U_2 may have an incentive to choose exclusivity and put U_1 in less favorable terms. This reasoning implies that U_1 will make a decision in stage 2 by comparing its payoff when both upstream firms choose exclusivity to that when both choose non-exclusivity.

The proof begins by checking whether $q_1 = q_2 = \frac{u_1}{\underline{k}} = \frac{u_2}{\underline{k}}$ holds at the equilibrium, in which an exclusive contract is made. Suppose so, then the profit of upstream firm U_1 would be $\pi_{U_1} = u_1 \cdot \frac{u_1}{\underline{k}} - \frac{1}{2}\underline{k}\left(\frac{u_1}{\underline{k}}\right)^2$. It must be $\pi_{U_1} = \pi_U^*$, because if $\pi_{U_1} < \pi_U^*$, U_1 would not have chosen exclusivity, but if $\pi_{U_1} > \pi_U^*$, downstream firm D_1 would have offered a lower u_1 to increase its profit. It follows from $\pi_{U_1} = \pi_U^*$ that

$$\frac{u_1^2}{\underline{k}} = \frac{\overline{k}}{\left(\overline{k}+3\right)^2}$$

or

$$u_1 = \frac{\sqrt{\underline{k}\overline{k}}}{\overline{k}+3} .$$

Consider an unconstrained Cournot equilibrium output when $u_1 = u_2 = \frac{\sqrt{\underline{k}\overline{k}}}{\overline{k}+3}$, which is

$$q_1^{uc} = q_2^{uc} = \frac{1-u_1}{3} = \frac{\overline{k}+3-\sqrt{\underline{k}\overline{k}}}{3\left(\overline{k}+3\right)} .$$

Note that the above output is feasible in the sense that it is compatible with the incentive of an upstream firm, or $q_1^{uc} < \frac{u_1}{\underline{k}}$, given that

$$\frac{\bar{k}+3-\sqrt{\underline{k}\bar{k}}}{3\left(\bar{k}+3\right)}-\frac{u_1}{\underline{k}}=\frac{\left(\sqrt{\bar{k}}-\sqrt{\underline{k}}\right)\left(\sqrt{\underline{k}\bar{k}}-3\right)}{3\sqrt{\underline{k}}\left(\bar{k}+3\right)}<0,$$

when $\underline{k}<\bar{k}\le 2$, which contradicts $q_1=\frac{u_1}{\underline{k}}$. Therefore, $q_1=q_2=\frac{u_1}{\underline{k}}=\frac{u_2}{\underline{k}}$ does not hold at the equilibrium, and a symmetric equilibrium, if any, must satisfy $q_1=q_2<\frac{u_1}{\underline{k}}$.

When $q_1=q_2<\frac{u_1}{\underline{k}}$, $q_1=q_2=\frac{1-u_1}{3}$ holds at the Cournot equilibrium. Hence, $u_1=u_2$ form an equilibrium if D_1 offers the lowest u_1 satisfying $\pi_{U_1}\left(u_1\right)\ge\pi_U^*$ or equivalently,

$$\frac{u_1\left(1-u_1\right)}{3}-\frac{1}{2}\underline{k}\left(\frac{1-u_1}{3}\right)^2\ge\frac{\bar{k}}{2\left(\bar{k}+3\right)^2},$$

and D_2 has an incentive to choose $u_2=u_1$. First, such u_1 exists because LHS is continuous in u_1, and LHS < RHS at $u_1=\frac{\sqrt{\underline{k}\bar{k}}}{\bar{k}+3}$, but LHS>RHS at $u_1=\frac{\bar{k}}{\bar{k}+3}$. To see LHS < RHS at $u_1=\frac{\sqrt{\underline{k}\bar{k}}}{\bar{k}+3}$, note from the above argument that when $u_1=u_2=\frac{\sqrt{\underline{k}\bar{k}}}{\bar{k}+3}$, $q_1=q_2=\frac{1-u_1}{3}<\frac{u_1}{\underline{k}}$ and thus $\pi_U=u_1q_1-\frac{1}{2}\underline{k}q_1^2<\frac{1}{2}\frac{u_1^2}{\underline{k}}=\frac{\bar{k}}{2\left(\bar{k}+3\right)^2}=\pi_U^*$.

Second, D_2 does not have an incentive to deviate from $u_2=u_1=u^{***}$, as shown below. If it offers a higher u_2, q_2 is smaller at the Cournot equilibrium, meaning that D_2 becomes worse off. If it offers a lower u_2, q_1 is smaller at the Cournot equilibrium and thus U_1 would not enter into an exclusive contract with D_1 at u_1, nor with D_2 offering a lower u_2. U_2 would make the same decision, meaning that D_2 ends up with a non-exclusive equilibrium payoff, which is less than the payoff when offering $u_2=u_1=u^{***}$. **Q.E.D.**

Proof of Proposition 2.

It directly follows from Lemma 3 that at the equilibrium in which downstream firms offer $u_1=u_2=u^{***}$, an exclusive contract is entered into and upstream firms earn $\pi_U\left(u^{***}\right)=\pi_U^*$. **Q.E.D.**

Proof of Lemma 4.

It is clear from the proof of Lemma 3 that $\frac{\sqrt{\underline{k}\bar{k}}}{\bar{k}+3} < u^{***} < u^{*} = \frac{\bar{k}}{\bar{k}+3}$. It is easy to see $\frac{\sqrt{\underline{k}}}{\underline{k}+3} < \frac{\sqrt{\bar{k}}}{\bar{k}+3}$ when $\underline{k} < \bar{k} \le 2$, and thus $u^{**} = \frac{\underline{k}}{2\underline{k}+3} < \frac{\underline{k}}{\underline{k}+3} < \frac{\sqrt{\underline{k}\bar{k}}}{\bar{k}+3} < u^{***}$. Now it follows that $q^{***} = \frac{1-u^{***}}{3} > \frac{1-u^{*}}{3} = q^{*}$ and that $p^{***} = 1-2q^{***} < 1-2q^{*} = p^{*}$.

Q.E.D.

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