

Exclusive Dealing Contracts in a Successive Duopoly with Side Payments*

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I. Introduction

Exclusive dealing is a way of securing partial vertical integration through contract. A “downward” exclusive dealing contract (EDC) is said to exist when a manufacturer (upstream) offers a sales contract to a buyer (downstream) conditioned upon the agreement that the buyer will not purchase goods from the manufacturer’s competitor. Thus, with a downward EDC, the dealer is “tied” to the supplier. Alternatively, an “upward” exclusive dealing contract exists when the buyer wishes to obtain an exclusive supply from the manufacturer so that its downstream rivals are foreclosed from that part of the upstream market.¹

Two possible reasons have been suggested as to why an exclusive dealing contract may exist: 1) there may be a possibility of gaining horizontal market power through vertical market foreclosure, 2) an exclusive dealing contract may create superior efficiency. It is apparent that these two conflicting views support completely opposite antitrust policies regarding exclusive dealings.

In order to better understand the issue, let us review some of these opposing viewpoints. A proponent of the original (now discredited) market foreclosure theory, Phillip Areeda [1], claimed that EDCs are predatory because they unfairly exclude rival firms from obtaining that part of the market. Areeda’s viewpoint came under intense attack by Robert Bork [2] who suggested that there exists no market power creation with EDCs, but only superior efficiencies. Bork argues that an EDC simply results in a realignment of the shipping patterns between upstream firms and downstream firms, and induces no welfare loss for consumers. Furthermore, even if there were a predatory intent behind EDCs, it would not be effective, since the excluded rival firms may contract with the remaining firms to contest the predatory tactic. Because in Bork’s view the excluded firm has this counter-strategy available, “unfair exclusion” is no longer a valid rationale for accusing EDCs of being predatory. However, implicit in Bork’s argument is the assumption that the counter-contracting by the excluded firm would somehow neutralize the adverse effect that market foreclosure may have on consumer welfare. This assumption is valid, if and only if, the

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1. The well-known “Keiretsu” system of the Japanese conglomerates is quite similar to the exclusive dealing contracts discussed in this paper. While those firms may not actually sign binding contracts, they are, nevertheless, bound by mutual understanding that any deviation from the accepted practice will be detrimental to the firm in the long run. In this sense, exclusive dealing practice among “Keiretsu” firms is self-enforcing.

counter-contracting by the excluded firm does occur in equilibrium and the resulting final good's price offered to consumers is not adversely affected. This point was not properly addressed in Bork [2].

More recent studies have examined the possibility of market foreclosure through raising rivals' costs [4; 5]. This theory of real foreclosure has replaced the discredited theory of Areeda's [1] by establishing the possibility that EDCs may induce more than simple realignment of shipping patterns—successful EDCs may raise rivals' costs by restraining the supply of inputs available to rivals or by inducing supplier collusion. It is notable that Krattenmaker and Salop offered strong arguments in support of the vertical foreclosure theory. However, their analysis also remains incomplete in that they do not formally address the issue of whether or not counter-contracting by the rival firms will, in fact, occur in equilibrium.²

The objective of this paper is to pursue an equilibrium analysis of exclusive dealing contracts, in which counter-contracting is a valid strategy. Our approach is to set up a two-stage market game in which firms make contract decisions in stage 1 and production decisions in stage 2. By allowing the firms to make both contract decisions and production decisions, we enable the potential victim to have an access to exclusive dealing contracts as well as its predator. The equilibrium contract configurations and the corresponding production outcome thus derived will allow us to properly evaluate the anti-competitive (or pro-competitive) nature of exclusive dealing contracts.

Ultimately, we are interested in answering the following questions: Do EDCs truly create market foreclosure by raising rival's costs? If they do, will excluded rivals choose not to contest the predatory strategy? Will the availability of a counter-strategy necessarily neutralize the adverse effect of market foreclosure on consumer welfare? The answers to these questions will have a significant impact on antitrust policies regarding exclusionary practices. If the market equilibrium entails the use of EDCs as a predatory weapon, and the availability of counter-strategy does not neutralize the welfare loss, then the antitrust authorities should consider exclusionary business practices as possible targets to pursue. While the final choice of the antitrust target in any given time would depend on the cost of carrying out the investigations under limited budget, our investigation will allow us to determine whether exclusive dealing contracts should qualify as a worthwhile target for the authorities to pursue.

II. The Model

Consider two vertically related industries. The upstream industry supplies (homogeneous) intermediate goods that are used as inputs by the downstream firms in producing (homogeneous) final goods for consumers. Both upstream and downstream industries are occupied by duopolists. Let (U_1, U_2) denote the upstream duopolists and (D_1, D_2) the downstream duopolists.

Denote by q_i the output level of the final good produced by a downstream duopolist i , $i = 1, 2$. Let x_j denote the output level of the intermediate good produced by an upstream duopolist j , $j = 1, 2$. For future reference, we may further specify x_{jk} as firm U_j 's supply of its intermediate good to firm D_k , where $x_j = x_{j1} + x_{j2}$, $(j, k = 1, 2)$. The production technology is such

2. An improvement in this direction was made in a recent paper by Ordober, Saloner, and Salop [6] in which they address the issue of equilibrium market foreclosure. While their model did allow the remaining firm to have the counter strategies, the analysis was strictly for the case of vertical integration.

that one unit of the intermediate good is needed to produce one unit of the final good. By assuming a linear production technology we eliminate the type of efficiency observed in vertical integration with variable proportions technology [11; 12]. Since in equilibrium the downstream's demand for the intermediate good must equal the upstream's supply of it, it will be true that $q_1 = x_{11} + x_{21}$ and $q_2 = x_{12} + x_{22}$.

For simplicity, demand for the final good is linear:

$$P(Q) = a - bQ, \quad \text{where } Q = q_1 + q_2. \quad (1)$$

The cost of production for the upstream firms is:

$$C^U(x_j) = cx_j, \quad j = 1, 2. \quad (2)$$

The cost of production for the downstream firms is:

$$C^D(q_i) = (w_i + k)q_i, \quad i = 1, 2. \quad (3)$$

w_i is the unit price at which firm i purchases the intermediate good, and k is the marginal cost of producing final goods net of the input purchasing cost. $a > c + k$ is assumed to insure existence of a Cournot equilibrium downstream.

In each level of this vertical structure, firms behave as Cournot duopolists competing in quantities. Final goods price is determined through the market demand function to clear the market. On the other hand, the input price, w_i , is dependent upon whether or not the downstream firm has a contract with an upstream supplier. In the absence of a contract, a downstream firm takes the input price offered in the market as given when maximizing its profits. This is equivalent to the standard assumption in the vertical integration literature that the downstream firms are price-takers in obtaining inputs. If the downstream firm has an exclusive dealing contract with an upstream firm, it purchases the input at the price specified in the contract. Furthermore, we assume that the contracting firms may make side payments among themselves. The existence of this side payment allows us to determine the contract incentives of the firms by looking only at their joint profits.³

There are two stages in this game. In stage 1, firms U_i and D_j (for any i or $j = 1, 2$), together, make a contract decision. The stage 1 strategy set of U_i and D_j is {No EDC, Upward EDC, Downward EDC}. This strategy set presents us with the following contractual configurations from the first stage: (No EDC–No EDC), (Upward EDC–No EDC), (Downward EDC–No EDC), (Upward (Downward) EDC–Upward (Downward) EDC). Note that if the rival firm has an Upward (Downward) EDC, then it should not matter whether the other firm has an Upward EDC or a Downward EDC. We, thus, assume that if both firms have some type of EDC simultaneously, they must be of the same type. Figure 1 shows us the flow of the intermediate good supply from upstream firms to downstream firms under various contractual configurations. Once the firms have made the contract decision, in stage 2 they engage in Cournot quantity competition in both levels of the vertical structure.

3. This type of side payments among exclusively dealing firms have been observed in the beer industry, where 'some brewers and beer wholesalers used "questionable payments" (or "blackbagging") in marketing their beer to selected retail accounts [3, 150].' Furthermore, the standard practice of selective discounts and bribes among the Japanese Keiretsu firms may be interpreted as that of shifting payments to maximize joint profits.

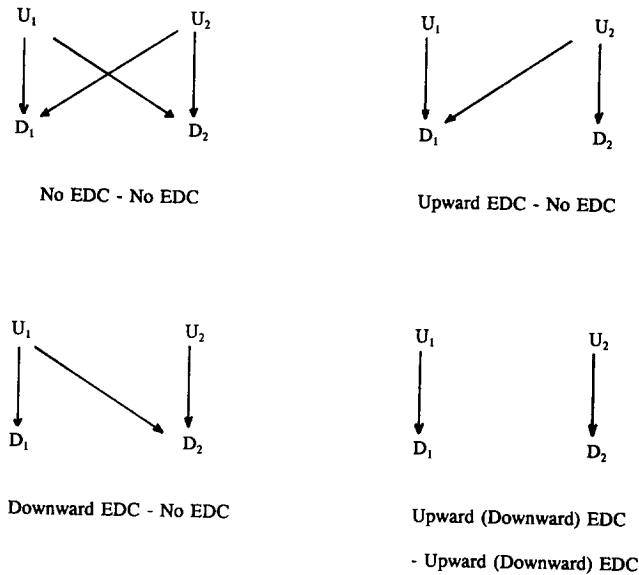


Figure 1. Contractual Configurations and Input Flow Possibilities

The solution concept used in this paper is that of subgame perfect equilibrium. We shall first examine the stage 2 quantity competition for each contractual configuration. The stage 1 contract decision will be made by choosing that contract which maximizes the joint profits of the contracting firms.

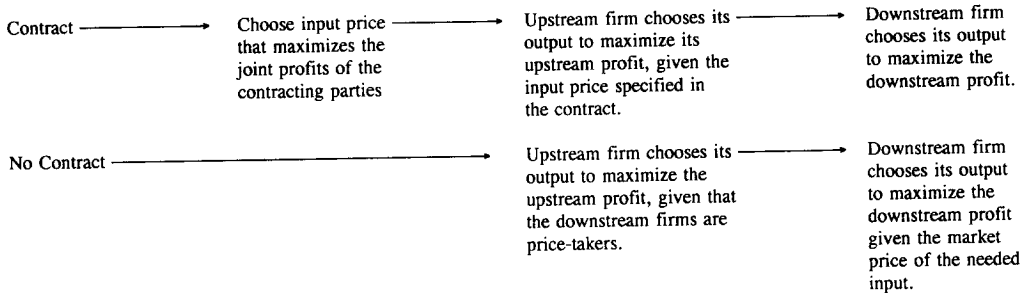
III. Stage-2 Quantity Competition

Given the contractual configuration determined by the stage-1 decisions, contracting firms in stage-2 would first agree on an input price which maximizes their joint profits. Once the optimal input price is agreed upon, the upstream contracting firm makes its production decision. Taking the inputs from the upstream partner at the specified price, the downstream firm makes its own production decision.

In order to solve for the contract input price and equilibrium outputs for firms in stage-2, we proceed backwards: First, solve for the equilibrium output rates of the downstream firms given that the contracting (downstream) firm takes the contract-specified input price as given and the non-contracting (downstream) firm takes the market price of input as given. A derived demand curve for the input faced by the upstream firms is then obtained from this Cournot equilibrium for the final good. The market price of the input is determined by a Cournot equilibrium based on that demand curve. The possibility of the contract-holding firms selling (buying) inputs to (from) the non-contracting firms is not ruled out. Rather, we endogenously derive the incentive (or disincentive) for the contracting firms to participate in the input market as a result of our analysis in Propositions 1 and 2. Once the equilibrium output rates for both upstream firms and downstream firms and the market price of intermediate good are determined, it is straightforward to derive the contract-specified input price: it is the one that maximizes the joint profits of the upstream and downstream contracting parties.

Note that the contract only specifies the input supply relationship and input price. While the

Exclusive Dealing Contracts



Vertical Integration

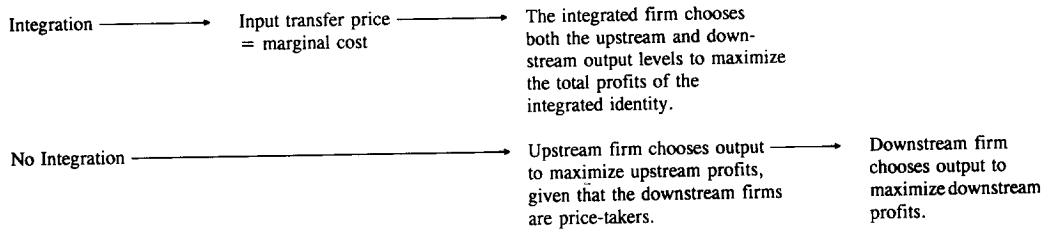


Figure 2. Time Line: Order of Events

optimal input price specified in the contract is obtained by maximizing joint profits, each contracting firm’s production decision is made through independent profit maximization. This is what differentiates exclusive dealing contracts from vertical integration, for vertically integrated firms would make production decisions through joint profit maximization as well. In order to clarify the structure of the game and emphasize the difference between exclusive dealing and vertical integration, we provide in Figure 2 the time line for both situations in the order of events.

In the following subsections, we shall consider the equilibrium outcomes under various contractual configurations.

No EDC–No EDC

We first consider the case where there exists no exclusive dealing contract among upstream and downstream firms. While firms are assumed to behave as Cournot duopolists in each level of this vertical structure, downstream duopolists are price-takers in purchasing their inputs from the upstream duopolists. In the absence of an exclusive dealing contract, the market price of the input will be unique and identical for both downstream firms. Thus, for the case of (No EDC–No EDC) we shall denote the market price of the input by w ($= w_1 = w_2$) for both firms.

Given that a unit of input is offered at the price, w , the downstream duopolists choose quantities to maximize their respective profit functions:

$$\pi_i^D(q_1, q_2) = P(q_1 + q_2)q_i - wq_i - kq_i, \quad i = 1, 2. \tag{4}$$

Substituting $P(q_1 + q_2) = a - b(q_1 + q_2)$ into (4) and simultaneously solving the reaction functions, we obtain the Cournot-Nash equilibrium output levels: $q_1^* = q_2^* = (a - w - k)/3b$.

Since one unit of input is needed to produce one unit of the final good, the total market

demand for the intermediate good is: $x_1 + x_2 = (2/3b)(a - w - k)$. Solving for w , we derive an inverse demand function for the intermediate good:

$$w(x_1, x_2) = a - k - (3b/2)(x_1 + x_2). \quad (5)$$

The upstream duopolists maximize the following profit functions with respect to their supply of inputs given the downstream firms' demand in (5):

$$\pi_j^U(x_1, x_2) = w(x_1, x_2)x_j - cx_j, \quad j = 1, 2. \quad (6)$$

Solving their respective reaction functions, we obtain the Cournot-Nash equilibrium outputs in the upstream duopoly: $x_1^* = x_2^* = (2/9b)(a - k - c)$. Given the equilibrium output rates in both upstream and downstream duopolies, it is straightforward to derive the equilibrium market prices and profit rates when firms have (No EDC–No EDC)—see Table I.

Downward EDC–No EDC

In this section, we analyze the behavior of firms when one of the upstream duopolists has a (downward) exclusive dealing contract with one of the downstream duopolists, while their rivals in both markets are not bound by any contract. In order to identify each firm, we shall denote by U_1 the upstream contract holder and D_1 the downstream contract holder. U_2 and D_2 denote the upstream and downstream firms not involved in contracting. Since U_1 and D_1 are bound by downward EDC, D_1 buys exclusively from U_1 . While U_1 may sell to both D_1 and D_2 , U_2 can only sell to D_2 under this configuration.

Remember that the contract specifies the price of the input flowing from the upstream contract holder to the downstream contract holder. Since side payments are possible in our model, this input price is determined by maximizing their joint profits given that the firms achieve Cournot equilibrium in each vertical market and the non-contracting downstream firm takes as given the market price for its input.

We assume that D_1 purchases input from U_1 at the contract-specified price, w_1 . D_2 purchases its necessary input at the market price, w_2 . The downstream profits functions are:

$$\pi_i^D(q_1, q_2) = [a - b(q_1 + q_2)]q_i - w_i q_i - k q_i, \quad i = 1, 2. \quad (7)$$

We derive the reaction functions under the Cournot assumption that firms take rival's output fixed:

$$\psi_1(q_2) = [(a - w_1 - k)/2b] - (1/2)q_2, \quad (8)$$

$$\psi_2(q_1) = [(a - w_2 - k)/2b] - (1/2)q_1. \quad (9)$$

Solving (8) and (9) simultaneously, we obtain the equilibrium quantities of the downstream firms:

$$q_1^* = (a - 2w_1 + w_2 - k)/3b, \quad (10)$$

$$q_2^* = (a - 2w_2 + w_1 - k)/3b. \quad (11)$$

Recall that x_{ij} denotes the firm U_i 's supply of its intermediate good to the firm D_j ($i, j = 1, 2$), where $x_i = x_{i1} + x_{i2}$. Since demand must equal supply in equilibrium, we observe that $x_{11} = q_1^*$

Table I. Equilibrium Prices, Quantities, and Payoffs

	NO EDC-NO EDC	UPWARD EDC-NO EDC	DOWNWARD EDC-NO EDC	EDC-EDC
w_1^*	$(1/3)(a + 2c - k)$	c	c	c
w_2^*	$(1/3)(a + 2c - k)$	$(1/4)(a + 3c - k)$	$(1/6)(a + 5c - k)$	c
x_1^*	$(2/9b)(a - c - k)$	$(5/12b)(a - c - k)$	$(1/2b)(a - c - k)$	$(1/3b)(a - c - k)$
x_2^*	$(2/9b)(a - c - k)$	$(1/6b)(a - c - k)$	$(1/9b)(a - c - k)$	$(1/3b)(a - c - k)$
π_1^U	$(2/27b)(a - c - k)^2$	0	$(1/54b)(a - c - k)^2$	0
π_2^U	$(2/27b)(a - c - k)^2$	$(1/24b)(a - c - k)^2$	$(1/54b)(a - c - k)^2$	0
q_1^*	$(2/9b)(a - c - k)$	$(5/12b)(a - c - k)$	$(7/18b)(a - c - k)$	$(1/3b)(a - c - k)$
q_2^D	$(2/9b)(a - c - k)$	$(1/6b)(a - c - k)$	$(2/9b)(a - c - k)$	$(1/3b)(a - c - k)$
π_1^D	$(4/81b)(a - c - k)^2$	$(25/144b)(a - c - k)^2$	$(49/324b)(a - c - k)^2$	$(1/9b)(a - c - k)^2$
π_2^D	$(4/81b)(a - c - k)^2$	$(1/36b)(a - c - k)^2$	$(4/81b)(a - c - k)^2$	$(1/9b)(a - c - k)^2$
$P^*(Q)$	$(1/9)(5a + 4c + 4k)$	$(1/12)(5a + 7c + 7k)$	$(1/18)(7a + 11c + 11k)$	$(1/3)(a + 2c + 2k)$

and $x_{12} + x_{22} = q_2^*$. Obviously, $x_{21} = 0$ under downward EDC. If in equilibrium x_{12} is greater than zero, then we may conclude that the contracting firm participates in the intermediate goods market. Given the fact that q_2^* is produced by D_2 using the inputs purchased in the market, the market inverse demand for D_2 's inputs can be derived from (11):

$$w_2(x_{12}, x_{22}) = [(a + w_1 - k)/2] - (3b/2)(x_{12} + x_{22}). \quad (12)$$

We may also rewrite q_1^* as a function of x_{12} and x_{22} by substituting (12) into (10):

$$q_1^*(x_{12}, x_{22}) = [(a - w_1 - k)/2b] - (1/2)(x_{12} + x_{22}). \quad (13)$$

Having defined the inverse market demand for inputs as in (12) and recalling that $x_{11} = q_1^*(x_{12}, x_{22})$ and $w_2 = w_2(x_{12}, x_{22})$, the upstream profits can be written as follows:

$$\pi_1^U = (w_1 - c)x_{11} + (w_2 - c)x_{12} = (w_1 - c)q_1^*(x_{12}, x_{22}) + [w_2(x_{12}, x_{22}) - c]x_{12}, \quad (14)$$

$$\pi_2^U = (w_2 - c)x_{22} = [w_2(x_{12}, x_{22}) - c]x_{22}. \quad (15)$$

Since U_1 must supply all that is required by D_1 , its decision is over x_{12} rather than x_{11} . U_2 's decision is over x_{22} . Maximizing π_1^U and π_2^U over x_{12} and x_{22} respectively, we obtain the following reaction functions:

$$\psi_{12}(x_{22}) = \begin{cases} (1/6b)(a - c - k) - (1/2)x_{22} & \text{for } x_{22} \leq (1/3b)(a - c - k), \\ 0 & \text{for } x_{22} > (1/3b)(a - c - k). \end{cases} \quad (16)$$

$$\psi_{22}(x_{12}) = \begin{cases} (1/6b)(a + w_1 - 2c - k) - (1/2)x_{12} & \text{for } x_{12} \leq (1/3b)(a + w_1 - 2c - k), \\ 0 & \text{for } x_{12} > (1/3b)(a + w_1 - 2c - k). \end{cases} \quad (17)$$

Solving for the equilibrium output rates from the above reaction functions, we obtain:

$$x_{12}^* = \begin{cases} [(a - k - w_1)/9b] & \text{if } w_1 \leq a - k, \\ 0 & \text{if } w_1 > a - k. \end{cases} \quad (18)$$

$$x_{22}^* = \begin{cases} [(a + 2w_1 - 3c - k)/9b] & \text{if } w_1 \leq a - k, \\ [(a + w_1 - 2c - k)/6b] & \text{if } w_1 > a - k. \end{cases} \quad (19)$$

Note from (13) that $w_1 \leq a - k$ is necessary for a duopoly solution to exist in downstream production. Thus, ruling out the case of $w_1 > a - k$, we get the following unique values for x_{12}^* and x_{22}^* .

$$x_{12}^* = [(a - k - w_1)/9b], \quad (20)$$

$$x_{22}^* = [(a + 2w_1 - 3c - k)/9b]. \quad (21)$$

PROPOSITION 1. *Under (Downward EDC–No EDC), U_1 participates in the intermediate goods market.*

This proposition is immediate from observing $x_{12}^* > 0$. It is interesting to observe that U_1 participates in the input market selling its input to D_2 even when it is holding a contract with D_1 . This result is in contrast to that obtained in the existing vertical integration literature: vertically integrated firms typically stay out of the intermediate goods market [8, 348]. The intuition behind the different results is as follows. While the vertically integrated firm chooses outputs that maximize

joint profits, the exclusive dealing firms choose their outputs independently. In the case of the integrated firm, participating in the integrated goods market is suboptimal because it adversely affects the downstream division's profit. Since the integrated firm maximizes the joint profit, including the downstream division's profit, it prefers to stay away from the intermediate goods market. On the other hand, an exclusive dealing firm feels the adverse impact of its participation in the intermediate goods market to a much smaller extent, since it makes the output decision on the basis of its individual profits [even though the contract input price is specified to maximize joint profits].

Having derived the equilibrium output rates as functions of the contract input price, w_1 , we proceed to calculate the optimal input price that the contract specifies. Let us first write down the profits of the firms holding the downward exclusive dealing contract as functions of w_1 :

$$\begin{aligned}\pi_1^U &= (w_1 - c)[(7a - 10w_1 - 7k + 3c)/18b] \\ &\quad + [(a + 2w_1 - k - 3c)/6][(a - k - w_1)/9b],\end{aligned}\quad (22)$$

$$\pi_1^D = [(7a - 10w_1 - 7k + 3c)^2/324b].\quad (23)$$

Define by $\hat{\pi}$ the joint profits of the contract holding firms such that $\hat{\pi} \equiv \pi_1^U + \pi_1^D$. It is then straightforward to show that $\partial \hat{\pi} / \partial w_1 < 0$. This implies that the optimal input price is the marginal cost of producing the intermediate good: $w_1^* = c$. Thus, (downward EDC–No EDC) configuration produces the results in Table I.

Upward EDC–No EDC

We now consider the behavior of firms when one of the downstream duopolists has an upward exclusive dealing contract with one of the upstream duopolists. As described in the introduction, an upward EDC prohibits the upstream contract holder from selling his intermediate goods to the downstream contract holder's rival. Therefore, if strategic use of upward EDC is successful, the downstream contract holder's rival is partially foreclosed from the input market.

Once again, we denote by U_1 and D_1 the upstream contract holder and downstream contract holder respectively. U_2 and D_2 are the upstream and downstream firms which are not involved in any contract. Under the upward EDC (as in the case of downward EDC), D_1 purchases input from U_1 at the contract specified price, w_1 . D_2 purchases its necessary input at the market price, w_2 . As in the case of downward EDC, one question which needs to be addressed is whether or not the contracting parties would engage in the intermediate goods market. While D_1 asks U_1 not to sell to D_2 , it may be profitable for D_1 to purchase part of its input from U_2 . Since nothing in the contract prohibits D_1 's purchase of input from U_2 , we must consider this possibility.

At the downstream level, it is intuitively obvious that D_1 will purchase from U_2 if and only if $w_2 < w_1$. If $w_1 \leq w_2$, then the profit maximizing D_1 will purchase all of its input needs from U_1 . Initially, we shall make a conjecture that $w_1 \leq w_2$, and let D_1 purchase its input from U_1 only. It will be shown later that our initial conjecture was indeed a correct one. Under this conjecture, we may write the downstream profit functions as follows:

$$\pi_i^D(q_1, q_2) = [a - b(q_1 + q_2)]q_i - w_i q_i - k q_i, \quad i = 1, 2.\quad (24)$$

As can be seen above, the downstream profits functions for upward EDC are the same as those for (Downward EDC–No EDC). Thus, $q_1^* = (a - 2w_1 + w_2 - k)/3b$ and $q_2^* = (a - 2w_2 + w_1 - k)$

/3b. Given the (Upward EDC–No EDC) configuration and our initial conjecture that $w_1 \leq w_2$, it is straightforward that $x_{11} = q_1^*$, $x_{12} = 0$, $x_{21} = 0$, and $x_{22} = q_2^*$.

Since D_2 's purchase of input from U_2 is carried out in the market, we may write the market inverse demand for x_{22} as

$$w_2(x_{22}) = (1/2)(a + w_1 - k) - (3/2)bx_{22}. \quad (25)$$

Having defined the inverse market demand for x_{22} , the upstream profits can be written as

$$\pi_1^U = (w_1 - c)x_{11}, \quad (26)$$

$$\pi_2^U = (w_2 - c)x_{22} = [(1/2)(a + w_1 - k) - (3/2)bx_{22} - c]x_{22}. \quad (27)$$

Recall that $x_{11}^* = q_1^*$. Maximizing π_2^U with respect to x_{22} and using (25), we obtain

$$x_{11}^*(w_1) = (5a - 7w_1 - 5k + 2c)/12b, \quad (28)$$

$$x_{22}^*(w_1) = (a + w_1 - k - 2c)/6b. \quad (29)$$

Having derived the equilibrium output rates as functions of w_1 , we proceed to maximize the joint profit of the contracting firms, $\hat{\pi} \equiv \pi_1^D + \pi_1^U$, where

$$\hat{\pi} = (w_1 - c)[(5a - 7w_1 - 5k + 2c)/12b] + [(5a - 7w_1 - 5k + 2c)^2/144b]. \quad (30)$$

It is easy to show that $\partial\hat{\pi}/\partial w_1 < 0$ for all $w_1 \geq c$. Thus, the optimal contract input price is $w_1^* = c$.

PROPOSITION 2. *Under (Upward EDC–No EDC), D_1 does not participate in the intermediate goods market.*

Previously, we conjectured that $w_1 \leq w_2$. Under this conjecture, we found the joint profit maximizing input price, $w_1^* = c$. Then, it is straightforward to obtain $w_2^* = (1/4)a + (3/4)c - (1/4)k$. In equilibrium, we then observe $w_1 \leq w_2$ as long as $a - c - k \geq 0$, which is the basic condition for our model to have a solution. Therefore, our initial conjecture is unambiguously confirmed. The intuition behind Proposition 2 is that when the downstream firm holds Upward EDC, the contract input price is lower than what the market can offer, i.e., $w_1 \leq w_2$. Thus, there is no incentive for it to buy needed inputs from U_2 . The market equilibrium under (Upward EDC–No EDC) is described in Table I.

Upward (Downward) EDC–Upward (Downward) EDC

Each downstream firm has a contract with each upstream firm. Since U_1 solely supplies to D_1 and U_2 solely supplies to D_2 , U_1 and U_2 do not compete for customers. Let us denote by w_1 the input price D_1 is facing from U_1 and w_2 the input price D_2 is facing from U_2 . The profit functions for D_1 and D_2 can then be written as

$$\pi_i^D(q_1, q_2) = [a - b(q_1 + q_2)]q_i - w_i q_i - k q_i, \quad i = 1, 2. \quad (31)$$

Taking the first order conditions and solving the reaction functions simultaneously, we obtain the equilibrium output rates: $q_1 = (a - 2w_1 + w_2 - k)/3b$ and $q_2 = (a + w_1 - 2w_2 - k)/3b$.

Expressing π_1^U and π_2^U as functions of w_1 and w_2 ,

$$\pi_1^U = (w_1 - c)[(a - 2w_1 + w_2 - k)/3b], \quad (32)$$

$$\pi_2^U = (w_2 - c)[(a - 2w_1 + w_2 - k)/3b]. \quad (33)$$

Let $\hat{\pi}_1(w_1, w_2) \equiv \pi_1^D(w_1, w_2) + \pi_1^U(w_1, w_2)$ and $\hat{\pi}_2(w_1, w_2) \equiv \pi_2^D(w_1, w_2) + \pi_2^U(w_1, w_2)$. After some tedious calculations, it can be shown that $\partial \hat{\pi}_1 / \partial w_1 < 0$ for all values of $w_1 \geq c$ and $\partial \hat{\pi}_2 / \partial w_2 < 0$ for all values of $w_2 \geq c$. Thus, the optimal contract input prices are $w_1^* = w_2^* = c$.

IV. Stage-1 Contract Game and Subgame Perfect Equilibrium

In section III, we derived equilibrium profits for both upstream and downstream firms under various contractual configurations. These equilibrium outcomes from stage-2 games are listed in Table I. In this section, we solve the stage-1 contract game given these stage-2 outcomes.

Recall that the strategy set, S , of U_i and D_j is {No EDC, downward EDC, Upward EDC}. Let $\hat{\pi}_1(s)$ denote the sum of profits obtained by U_1 and D_1 when they pursue strategy $s \in S$ in stage 1. $\hat{\pi}_2(s)$ then denotes the sum of profits obtained by U_2 and D_2 in stage-2 when they pursue a strategy $s \in S$. Because contracting firms are assumed to redistribute their profits among themselves with side payments, they would choose a particular contractual strategy, s , over another, if and only if, the value $\hat{\pi}_1(s)$ exceeds that of any other strategies in S .

Letting $B \equiv (a - c - k)^2/b$, we may represent the stage-1 contract game in a payoff-matrix form as shown in Figure 3. Each entry in the matrix represents the values of $\hat{\pi}_1(s)$ and $\hat{\pi}_2(s)$ under each contractual configuration. Notice that the payoff boxes for Upward (Downward) EDC–Downward (Upward) EDC are classified to be irrelevant. When the rival firms are holding an Upward (Downward) EDC, signing a Downward (Upward) EDC would be meaningless since the supply relationship remains the same whether they have the EDC or not.

THEOREM. *The subgame perfect equilibria for the Contract–Output game entail full contracting: (Upward EDC–Upward EDC) and (Downward EDC–Downward EDC). Corresponding equilibrium outputs are: $x_1^* = x_2^* = q_1^* = q_2^* = (1/3b)(a - c - k)$.*

Proof. Since $(11/162)B < (5/72)B < (1/9)B < (10/81)B < (55/324)B < (25/144)B$, it is straightforward that there exist two Nash equilibria in the stage-1 contract game: (Upward EDC–Upward EDC) and (Downward EDC–Downward EDC). For both contractual configurations, corresponding Nash equilibrium in stage-2 output game entails $x_1^* = x_2^* = q_1^* = q_2^* = (1/3b)(a - c - k)$ as shown in Table I under EDC–EDC. Q.E.D.

The subgame perfect equilibrium in our contract-output game involves full contracting by the firms in the vertically related markets. This implies that if an upstream (downstream) firm is foreclosed from the downstream (upstream) market by its rival through a downward (upward) EDC, it *will* contest the predatory strategy by contracting with a downstream (upstream) firm which is not involved with its rival.

$U_2 - D_2$	No EDC	Upward EDC	Downward EDC
$U_1 - D_1$			
No EDC	(10/81)B, (10/81)B	(11/162)B, (55/324)B	(5/72)B, (25/144)B
Upward EDC	(55/324)B, (11/162)B	(1/9)B, (1/9)B	Irrelevant
Downward EDC	(25/144)B, (5/72)B	Irrelevant	(1/9)B, (1/9)B

Figure 3. Payoff Matrix for Stage - 1 Contract Game

V. Discussions

The first thing to note from Figure 3 is that the firms are in a prisoner's dilemma situation. While both $U_1 - D_1$ and $U_2 - D_2$ prefer not to have any exclusive dealing contracts, this is not an equilibrium outcome. Given that $U_2 - D_2$ ($U_1 - D_1$) has no contract, $U_1 - D_1$ ($U_2 - D_2$) prefers to pursue exclusive dealing so as to benefit from eliminating upstream marginalization and potentially foreclose $U_2 - D_2$ ($U_1 - D_1$). Conversely, if $U_2 - D_2$ ($U_1 - D_1$) does have a contract, then $U_1 - D_1$ ($U_2 - D_2$) must counter that strategy by pursuing a contract themselves so as not to be foreclosed from the relevant market. Since both $U_1 - D_1$ and $U_2 - D_2$ have the same incentives, the only stable equilibrium is that of (Upward EDC (Downward EDC)–Upward EDC (Downward EDC)). An implication of this outcome is that of the “bandwagon effect:” an exclusive dealing arrangement between an upstream supplier and a downstream buyer may trigger further exclusive dealing relationships between their rivals in the industry, resulting in a full exclusive dealing structure.⁴

The second issue is that of market foreclosure by raising rival's cost. The questions we initially posed were as follows: Do EDCs truly create market foreclosure by raising rival's costs? If they do, will excluded rivals choose not to contest the predatory strategy? Will the availability of a counter-strategy necessarily neutralize the adverse effect of market foreclosure on consumer welfare? In answering these questions, we use the definition of market foreclosure given in Salinger [8, 353]: Market foreclosure of a downstream firm is inferred from an increase in the input price that the excluded firm is facing. Market foreclosure of an upstream firm is inferred from an increase in the difference between the final goods price and the price of input.⁵

Using the above definitions, we immediately realize that there is no market foreclosure existing in any of the exclusive dealing contracts considered here. In the case of (Upward EDC–No EDC), D_2 is not foreclosed from the market since w_2^* has actually declined from $(1/3)(a + 2c - k)$ to $(1/4)(a + 3c - k)$. If anything, an upward EDC between U_1 and D_1 seems to have benefitted D_2 by lowering its input cost. The explanation for this phenomenon lies in the optimal input price specified in the contract. With an Upward EDC, U_1 supplies to D_1 at marginal cost, c . Because of low input cost, D_1 optimally expands its production of final good. In response

4. This seems to be exactly what is happening in U.S., as the American companies are trying to emulate the Japanese keiretsu in an effort to compete more effectively. It has been observed that Eastman Kodak and Motorola are building up their own mini-keiretsu in retaliation to the Japanese rivals [7].

5. See Salinger [8, 353] for justifications.

to D_1 's expansion, D_2 must contract its output along its reaction curve which means an inward shift of its demand curve for input. Since D_2 's demand for input decreased simultaneously with the inward shift of the input supply curve due to exclusion, the market price of the input faced by D_2 depends on the relative magnitude of decline in demand and supply. In our model, the decline in demand dominates the simultaneous decline in supply, resulting in a lower input price for D_2 . It is important to note, however, that even with a lower input price, D_2 experiences a decline in its profitability due to the loss of market share in the final goods market. This is what gives D_2 the incentive to retaliate by counter-contracting with U_2 .

In the case of (Downward EDC–No EDC), the foreclosure of U_2 from the downstream market also appears to be non-existent (using Salinger's definition). In fact, $P^*(Q) - w_2^*$ remains the same whether or not U_1 and D_1 have a downward EDC against U_2 . While $P^*(Q) - w_2^*$ remained constant, the joint profits of U_2 and D_2 both declined considerably. The decline in joint profits of U_2 and D_2 is primarily due to the decline in the profit level of U_2 . As U_1 supplies input to D_1 at marginal cost, c , under the downward EDC, D_1 optimally expands its supply of final goods. If w_2^* were to remain constant, D_2 , moving along its reaction curve, would have an incentive to contract its supply giving up some of the market share. However, w_2^* was affected by the low input transfer price among U_1 and D_1 , and went down sufficiently to enable D_2 to keep its supply of final goods constant. Since the decline in the final goods price $P^*(Q)$ is matched by a decline in w_2^* , D_2 's profit is unaffected by the downward EDC between U_1 and D_1 . On the other hand, U_2 suffers a great deal from the EDC since its supply of input, as well as its price, went down considerably. Thus, even though there appears to be no market foreclosure using Salinger's [8] definition, U_2 is unambiguously harmed by the downward EDC. Once again, we find that the excluded firm U_2 has every incentive to retaliate by signing a downward EDC with D_2 .

The final issue is that of consumer welfare resulting from the equilibrium price of the final good. As can be seen from Table I, $P^*(Q)$ is consistently lower with exclusive dealing contracts: $(1/9)(5a + 4c + 4k) > (1/12)(5a + 7c + 7k) > (1/18)(7a + 11c + 11k) > (1/3)(a + 2c + 2k)$. Both (Upward EDC–No EDC) and (Downward EDC–No EDC) provide us with a lower equilibrium price for the consumers than (No EDC–No EDC). When the firms are fully contracting, i.e., (EDC–EDC), the equilibrium price is at its lowest. The reasoning behind this result is straightforward. Since the firms having an exclusive dealing contract transfer necessary inputs at its marginal cost, they eliminate a double marginalization at one side of the market when the contractual configuration is either (Upward EDC–No EDC) or (Downward EDC–No EDC)—the contracting downstream firm is able to pass the cost savings on to the consumers in the form of a lower final good's price. When all the firms are contracting such that (EDC–EDC) is observed, this elimination of double marginalization is observed on both sides of the market—both $U_1 - D_1$ and $U_2 - D_2$ eliminate the upstream marginalization. This result is somewhat reminiscent of the famous Spengler's [10] result obtained in the model of vertical integration. While we are looking at exclusive dealings rather than vertical integrations, the essential intuition remains the same—product price is lower with vertical integration or exclusive dealing contract because double marginalization is eliminated.

VI. Conclusion

In this paper, we analyzed the market equilibrium in a successive duopoly, where firms made decisions over both exclusive dealing contracts and output rates. The subgame perfect equilibrium

of the game was observed to involve full contracting by the firms, (EDC–EDC). Furthermore, neither Upward EDC nor Downward EDC was seen to cause market foreclosure. When a firm is strategically excluded by an Upward (Downward) EDC, we observed that it has every incentive to retaliate by signing an Upward (Downward) EDC with a remaining firm in the upstream (downstream) market. With both types of EDC's, we found that the upstream contracting firm will optimally transfer inputs to the downstream partner at marginal cost. This elimination of marginalization benefitted the consumers in the form of a lower equilibrium final good's price.

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