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EQUILIBRIUM VERTICAL FORECLOSURE

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I. Introduction

The competitive effects of vertical mergers have long been a source of controversy in economics and antitrust. This paper is concerned with vertical foreclosure, one of the central issues in that debate. Vertical foreclosure concerns the exclusion that results when unintegrated downstream rivals are foreclosed from the input supplies controlled by the firm that integrates. Analogous effects occur when unintegrated upstream competitors are foreclosed from selling to the downstream division of the integrated firm.[1]

While the foreclosure argument has been accepted in leading court decisions[2] and policy guidelines[3], critics maintain that the theory itself is logically flawed. They claim that a vertically integrated firm will have no incentive to exclude its rivals, and if it did try to exclude them, rivals could protect themselves by contracting with other unintegrated firms.[4]

This controversy can be seen more clearly by making the vertical foreclosure theory more specific.[5] According to the theory, a single vertical merger can disadvantage downstream rivals as follows.[6] Consider a market in which the supply of inputs is competitive before the merger and there are no production efficiency benefits gained from vertical integration. After the merger, suppose the upstream division of the now-integrated firm refuses to supply inputs to the rivals of its downstream division.

This foreclosure of rivals from these supplies means that remaining suppliers will face less competition. As a result, they may be able to increase their profits by raising their input prices to the unintegrated downstream firms.[7] These higher prices benefit the vertically integrated firm. If rivals' costs of inputs are increased, they will be forced to reduce their production and raise the prices they charge in the downstream market. This reduction in

competition allows the downstream division of the integrated firm to increase its market share and its price. Thus the profits of the vertically integrated firm can rise, even if there are no production efficiency benefits flowing from the vertical integration.

The critics of vertical foreclosure raise a number of objections to these assertions. Each of these objections implies that the strategy of vertical integration and foreclosure of supply will not increase the overall profitability of the integrated firm. The objections deny the ability to use power in one market to "leverage" into a position of power in a second market. For example, Bork (1978, p.231) concludes:

> "Vertical merger does not create or increase the firm's power to restrict output. The ability to restrict output depends on the share of the market occupied by the firm. Horizontal mergers increase market share, but vertical mergers do not...Adherence to an economic fallacy as old as antitrust policy, however, has caused the law to take an entirely different course".

There are five main objections to the foreclosure theory. First, critics assert that it may not be profitable for the integrated firm to foreclose its downstream rivals. Although the profits of the downstream division rise, the upsteam division of the integrated firm loses input sales from its refusal to deal with rival downstream firms. These lost upstream profits may exceed the increased downstream profits. As a result, it does not follow necessarily that it is in the interest of the vertically integrated firm to foreclose downstream rivals.

Second, remaining suppliers may not have the incentive to raise their input prices. The foreclosure theory relies on the incentive of remaining suppliers to increase their input prices

after they no longer face competition in the input market from the integrated supplier. But this reduction in competition is more apparent than real. If the remaining suppliers raise their input prices, downstream firms often can begin to produce the input themselves.

Even if such entry is assumed to be impossible, raising prices may still be unprofitable. If the remaining suppliers raise prices, their downstream customers will be placed at a cost disadvantage vis-a-vis the integrated firm and will be forced to reduce their input purchases. Stated more directly, unintegrated firms' input demands are highly elastic. Consequently, suppliers' incentives to increase prices even after the integrated firm forecloses those rivals from its input production are low.

Third, the foreclosed rivals have available a number of alternative counterstrategies to battle their exclusion. In particular, they can respond by vertically integrating with the remaining unintegrated input producers. This will enable them to obtain the inputs at the competitive price, thereby eliminating their cost disadvantage. Thus, the first firm to integrate will gain no market power.

Fourth, it is not obvious that the first downstream firm's bid to integrate with an upstream firm will succeed to begin with. The vertical foreclosure theory suffers from a potential holdout problem. Assuming that remaining input producers gain the power to increase their input prices to unintegrated downstream buyers, a holdout supplier would gain an advantage by remaining unintegrated. Unless the downstream firm bids enough to compensate its potential merger partner for this lost opportunity, its bid will fail. Each firm will hold out, in the anticipation that another supplier will merge and give it the ability to profitably raise its input price.

If the downstream firm does try to compensate its potential merger partner for this lost opportunity, the profitability of the merger is decreased, possibly to the point that no merger will occur.

Finally, the vertical foreclosure theory suffers from one last potential flaw. Since the firm that is foreclosed is placed at a disadvantage, it ought itself to participate in the bidding for the scarce upstream resource. While this flaw is somewhat different from the earlier criticisms, in that it does not amount to a claim that vertical foreclosure will fail, it does make the theory incomplete.

In this paper, we set out a complete, but analytically tractable equilibrium model to evaluate the logic of the standard vertical foreclosure argument as well as the arguments advanced by its critics. Even though our model is simple, it's features include the incentives of the integrated firm and remaining unintegrated input suppliers to exclude rivals, the possible counterstrategies of competitors to these threats of foreclosure and the potential holdout problem. It also deals explicitly with the bidding for the scarce upstream resource.

We analyze the simplest vertical structure capable of capturing the essential elements of interest. In particular, we consider successive duopoly: two upstream firms provide a homogeneous input to two downstream producers. Each downstream firm produces a differentiated product in competition with its rival. In order to focus exclusively on foreclosure rather than efficiency, we have structured the model so that double marginalization does not arise when the firms are unintegrated. This is accomplished by assuming Bertrand competition upstream and that the downstream firms use the input in fixed proportions.[8]

We then allow for the possibility that a downstream firm

acquires one of the upstream suppliers, leaving the rival with a single independent upstream supplier. If the integrated firm refuses to supply the unintegrated downstream firm, the remaining upstream supplier is endowed with a monopoly. In order to achieve this foreclosure, however, we require that the integrating downstream firm outbid its rival for the acquisition of the upstream firm, i.e., we require bidding for the right to foreclose. Further, we do not assume that the integrated firm will refuse to deal with the remaining downstream rival. Rather, we examine several different scenarios for the way in which the input prices are determined. Finally, we examine the possibility that the remaining downstream rival is able to counter the effect of the first vertical merger by merging with the remaining supplier.

In our fully specified model, vertical foreclosure <u>can</u> emerge in equilibrium which in and of itself suggests that the critics of the foreclosure theory have been relying on a poorly specified model. The key necessary condition for this to occur is that the sum of the profits of the unintegrated firms must be higher if they remain unmerged than if they counter the initial merger by merging themselves. Two features of the market structure are necessary for this to pertain. First, the sum of the unintegrated firms' revenues must be locally increasing in the price of the input. This occurs with differentiated products because a small increase in one downstream firm's costs leads to an increase in both downstream prices. Since price competition drives downstream prices below the collusive level, such an increase in prices increases the revenue of both downstream firms.

Second, the increase in the input price that the unintegrated downstream firm faces must be moderate. If the unintegrated upstream firm has an incentive to raise its price

excessively, the unintegrated downstream firm will lose so much market share to its rival that its revenue will fall. Thus, whereas the conventional critique of foreclosure theory has questioned the ability of the remaining upstream firm(s) to raise price, ironically, in this model a necessary condition is that it not be able to raise its price too much. Its ability to raise the price will be limited if it faces competition from other substitutes. In particular, it is limited by the integrated firm announcing an input price of its own at which it is prepared to supply the rival downstream firm.

The paper is organized as follows: We begin by laying out the basic model in Section 2. That section also establishes the unintegrated and fully integrated outcomes as benchmarks for our further analysis. In Section 3, we analyze the model of vertical integration with differentiated products and establish the rationality of foreclosure in that setting.

Section 4 is devoted to a discussion of the robustness of the model to a variety of changes in the model specification. First, we discuss what happens if the downstream firms can bid for either upstream firm rather than specifying one of the upstream firms as the sole target (as we did in Section 3). Second, we examine how the results change when the upstream firms acquire the downstream firms rather than vice versa. We show that, in this case, it is possible for a holdout problem to arise, that is for each upstream firm to prefer to lose the bidding. We explain why this issue does not arise in the case where the downstream firms do the bidding.

Third, we consider the robustness of the model to a change in the nature of downstream competition. In particular we examine what happens when the downstream firms produce a homogeneous good

and choose outputs a la Cournot. Since a firm's revenue is decreasing in its costs in the case of quantity competition, one of the necessary conditions of the foreclosure argument fails. Here, the unintegrated firms always have an incentive to counter the effect of the initial merger by merging themselves.

Since vertical integration coupled with internal marginal cost pricing is but one possible form of vertical contract, we next turn our attention briefly to alternative contractual forms. In particular, we consider the case where an upstream and downstream firms can contract by means of two-part tariff which specifies a fixed payment and a unit price. In some sense, vertical integration is equivalent to a two-part tariff where the acquisition price of the upstream firm is the fixed fee and unit price equals marginal cost. Moreover, if it is possible for integrated firms to commit to a transfer price not equal to marginal cost, then the equivalence between vertical integration and a two-part tariff seems complete.

We argue, however, that this view is incorrect. A crucial aspect of vertical integration that is absent from a two-part tariff contract is the ability also to specify the price at which the input will be sold to the rival, or to exclude the rival altogether. We argue that a vertical contract lacking this provision (and antitrust laws generally prohibit such provisions) cannot be used as an instrument for foreclosure in our model. Setting an internal transfer price above marginal cost also raises difficulties. We show that the firms may have a mutual incentive to enter into such contracts in preference to simple vertical-integration-cum-marginal-cost-pricing if they are able to do so. We also show, however, that the firms have a strong incentive to "secretly" deviate from an above-cost transfer price. This latter incentive casts substantial doubt on the ability of the firms to adhere to such pricing in

practice.

Our paper is related to several other strands in the literature. The "exclusive dealing" literature typically examines what happens when upstream wholesalers offer exclusive contracts to downstream retailers who may or may not have local monopoly power.[9] For example, Mathewson and Winter (1986) examine a model where the upstream firms must bid for the right to obtain exclusive dealing franchises and where the rival supplier remains as a potential competitor.[10] If one interprets the retailer as an upstream firm in our model (since it provides a necessary input, retail distribution services), then there are some similarities in structure. There are several features which distinguish our model. The key difference is that in those models the upstream supplier is a local monopolist. Thus, the excluded downstream firm cannot counter the effects of the exclusion by entering into its own exclusive contract as it can in our setting. Further, in their model, exclusion is complete by the very definition of an exclusive contract. By contrast, our model explicitly considers the ability of the integrating firm to effect the exclusion.

There also are some similarities with work on "exclusive territories". Rey and Stiglitz (1986) examines how offering retailers exclusive territories can increase wholesalers' profits. In that model, although the establishment of exclusive territories endows the input suppliers (retailers) with some market power, this market power makes the wholesalers less competitive. Thus, even though double marginalization is introduced, the softening of competition can more than compensate. We abstract from such issues by constructing a model in which the downstream firms are worse off if both of their input prices rise equally.

Our work also is related to that of Salinger (1984, 1987).

He examines whether vertical integration between successive oligopoly leads to higher or lower final goods prices. Salinger also contrasts the case of quantity competition in a homogeneous goods model and price competition in a differentiated products model. His model is more general than ours in that he allows for successive oligopoly rather than duopoly, and he allows for differing numbers of upstream and downstream firms. However, he does not examine the issues of counterstrategies, bidding, optimal pricing, and optimal contracts that provide the focus of our paper. Finally, Mackay (1984) analyzes a model of the holdout problem in the case of horizontal merger to monopoly. This is closely related to the holdout problem that can arise in our model of vertical foreclosure.

2. The Industry Structure and Benchmark Outcomes

Two upstream firms, U1 and U2, provide a homogeneous good to two downstream firms, D1 and D2. In order to focus on this particular input, we suppress other inputs. This is equivalent to assuming that inputs are used in fixed proportions, an attractive assumption since it abstracts from the independent incentive to vertically integrate that arises in the variable proportions case.

Within this framework, there are numerous ways in which vertical relationships can be structured. In order to establish benchmark outcomes, it is useful to analyze two polar cases, (i) where neither downstream firm is vertically integrated (the "stand-alone" case) and (ii) where both are integrated and the input provided by the upstream unit is transferred internally at marginal cost. Where neither firm is vertically integrated, the input prices downstream firms face are determined by the nature of upstream competition.

Between these extremes lie a variety of alternative pricing mechanisms. For example, unintegrated firms may use long-term contracts to set nonlinear prices (such as two-part tariffs) while an integrated firm may be able credibly to commit to internal transfer prices different from marginal cost.

The vertical structure determines the prices that the downstream firm faces, which in turn affects downstream competition and the resulting equilibrium. In order to examine the link between vertical structure and downstream behavior, we begin by deriving the downstream equilibrium as a function of the input prices that the downstream firms face. By examining the effect of the vertical structure on input prices, we then can ascertain the effect of vertical structure on the market as a whole.

Throughout the paper we assume static competition between the downstream firms and concentrate on the case where the firms produce differentiated products and use prices as their strategic variables. We denote the input price that Di faces by c_i and assume that all firms have constant returns to scale. The demand function that Di faces is assumed to take the form:

$$q_i = a - bP_i + dP_j, \quad i = 1, 2$$

where the subscript j denotes the rival's price. Thus the goods are imperfect substitutes and the firms are symmetric. In order that output be more sensitive to the firm's own price than its rival's, we assume that $b > d$.

We now calculate the Bertrand-Nash equilibrium to this game. Di selects P_i to maximize its profits. Because inputs are used in fixed proportions and firms have constant returns to scale, profits are given by:

(1) $$\pi_{Di} = (P_i - c_i)(a - bP_i + dP_j).$$

The first-order condition yields:

(2) $\qquad P_i=(a+dP_j+bc_i)/2b.$

Substituting the first-order condition for P_j into that for P_i and solving yields:

(3) $\qquad P_i^*=[a(2b+d) + 2b^2c_i + bdc_j]/(4b^2-d^2),$

where the * denotes an equilibrium value.

Substituting the equilibrium prices into the demand function yields the equilibrium output:

$$q_i^*=b[a(2b+d) - c_i(2b^2-d^2) + bdc_j]/(4b^2-d^2).$$

The equilibrium profit for firm i is therefore

(4) $\qquad \pi_{Di}^*=b[a(2b+d) - c_i(2b^2-d^2) + bdc_j]^2/(4b^2-d^2)^2.$

An important feature of the equilibrium is that each firm's profit is increasing in the other's costs. It is this aspect of the structure that opens up the possibility that a firm might benefit by taking actions that place the rival at an input cost disadvantage

Notice too that in the case where $c_1=c_2=c_i$, firm i's equilibrium profit is

$$\pi_{Di}^*=b[a - c_i(b-d)]^2/(2b-d)^2.$$

Since $b>d$, equilibrium profits are decreasing in common unit costs. This is important because if it were not the case, there would be an incentive to accept a higher input price oneself in order to raise the rival's cost. The current formulation thus allows us to isolate any effects due purely to foreclosure.[11]

We assume that each upstream supplier is able to produce as much as it wants at constant marginal costs, which for simplicity we set at zero. Upstream competition, which is assumed to be Bertrand in prices, therefore yields $c_1=c_2=0$.

Since we assume that firms transfer input at true marginal cost if they are integrated, the downstream firms compete on the basis of $c_1=c_2=0$ when they are both vertically integrated, or when neither is. This model therefore has the attractive feature that

there is no difference in the market outcome either when both firms
are vertically integrated or when neither is. Again this is useful
because it allows us to abstract from possible efficiency rationales
for vertical merger and to focus instead on issues of foreclosure
and exclusion.

Thus, whether or not they are integrated, when both firms
have marginal costs of zero, equation (3) gives $P_i^* = a/(4b^2-d^2)$ and
equilibrium downstream profits are:

(5) $$\pi_D^{o*} \equiv a^2 b/(4b^2-d^2)^2,$$

where the superscript o denotes an initial or benchmark profit.

Within this framework the standard vertical foreclosure
argument can be stated simply as follows. D1 acquires U1 and
prevents U1 from supplying any downstream firm other than D1 itself.
This endows the remaining firms (in this case just U2) with some
power over price, which leads U2 to increase the price it charges
D2. With D2 placed at a resulting cost disadvantage, D1 is able to
increase its downstream price and its own profitability. Formally,
after the D1-U1 merger, U2 has a monopoly over D2. U2 knows that D1
will face an internal transfer price of zero (i.e., $c_1=0$) and that
it will face no competition from U1. U2 will set an input price c_2
to maximize profits, which are given by:

$$\pi_{U2}(c_2) \equiv c_2 q_2^*(c_2) = c_2 b[a(2b+d) - c_2(2b^2-d^2)]/(4b^2-d^2).$$

U2's optimal input price is given by $c_2^m \equiv a(2b+d)/2(2b^2-d^2)$
(where the superscript m denotes a monopoly price). Since D1's
profits are increasing in c_2, D1 is made better off. Conversely D2
is made worse off. Since, from equation (2), both downstream firms'
prices are increasing in both input prices, consumers also are worse
off. Thus D1's integration with U1 does indeed appear to have been
anticompetitive.

As discussed in the introduction, however, this argument for

the potential anticompetitive nature of vertical integration is unsatisfactory for several reasons. First, the above formulation arbitrarily assumes that U1 withdraws as a potential supplier of D2 after the merger. Is this always an optimal strategy for U1 or might there exist circumstances in which D1 would prefer to constrain U2's market power? Second, after the D1-U1 merger, D2 may be able to counter some of the anticompetitive effects of the merger by negotiating a more efficient contract with U2. One way of achieving this would simply be to merge with U2. Alternatively, it could enter into an agreement to purchase its input from U2 at a lower unit price in exchange for a fixed fee that would compensate U2 for giving up its monopoly price (a two-part tariff). Does the possibility of foreclosure still exist when we allow D2 a richer set of counterstrategies such as these? Finally, discussion so far leaves unexplained how D1 manages to acquire U1 in the first place. Since D2 should understand the effect that the foreclosure will have on its own profitability, why doesn't it intervene by outbidding D1 for control of the scarce resource?

In the following section we consider a richer model capable of shedding some light on these questions.

3. A Four-Stage Model

In order to incorporate all the features of interest, we analyze a game which has four stages. In the first stage, the "bidding" stage, the downstream firms have an initial opportunity to acquire one of the upstream suppliers.[12] If there is only one merger, following the convention of the previous section, we suppose it to be between D1 and U1. We denote the merged firm as firm 1.

In the second stage, input prices are determined. As we shall see, how input prices are set is a crucial determinant of the

equilibrium of the overall game. It is therefore important to be careful how one models the second stage.

If there was no vertical merger in stage 1, both downstream firms face input prices of zero. If D1 bought U1, however, it is less clear what assumption is most reasonable. Rather than concentrating on only one scenario, we contrast three possibilities:

(i)   Firm 1 and the unmerged upstream firm, U2, simultaneously choose the input prices at which they are prepared to supply D2 (a la Bertrand).

(ii)   Firm 1 can commit to not supplying D2 at all. In this case only, we consider the additional possibility that there is a substitute for the input supplied by U2 which is competitively supplied at a price of $c > 0$. While this assumption deviates from the assumption of upstream duopoly, it provides a way of parameterizing the upstream price. Note, in particular, that if c is sufficiently high, U2 has monopoly power over D2 as in the previous section.

(iii) Firm 1 is able to set an upper bound on the price that D2 faces by standing ready to supply it at a price of firm 1's choosing. To capture this formally, we consider the case in which firm 1 announces the linear price at which it is prepared to supply D2 before U2 announces its price.

The major modelling difference is between (ii) and (iii) on the one hand, and (i) on the other. When (i) pertains, the merged firm is unable to resist the temptation of competing with U2 for D2's business. However, a farsighted firm 1 will realize that entering into competition of this kind will lower D2's input price which, in turn, will lead to lower downstream prices. It would generally prefer, therefore, to exercise some restraint in this regard if it is able to do so. Assumption (ii) gives it this ability. However, this assumption is also restrictive since there

may be circumstances in which firm 1 wishes to be able to refrain from competing with U2 but, at the same time, to be able to prevent U2 from charging prices that are "too high". Assumption (iii) provides firm 1 with this additional control.

Thus firm 1 has increasing control over the price that D2 faces as one moves from assumption (i) through (iii). Our interest is in exploring the effect of this control on the equilibrium of the game. We comment on the relative merits of these assumptions later.

In the third stage, if the merger did occur, the unmerged downstream firm, D2, can attempt to acquire the remaining upstream firm. This allows us to analyze D2's ability to counter the anticompetitive effects of vertical foreclosure by its own parallel vertical merger.

In the fourth stage, downstream prices are chosen simultaneously, given input prices.

We solve for the equilibrium by backward induction. The final stage is simply the one-shot game solved in the previous section. So consider the third stage: If D1 and U1 have merged, should D2 make a bid for U2, and, if so, should it be accepted? The answer to this question depends on a comparison of the sum of the profits of U2 and D2 if they were to remain independent versus if they merge. If the latter profits are higher than the former, then the second vertical merger generates gains and we would expect such gains to be realized in an efficient bargain.

If D2 and U2 merge, both downstream firms then will be vertically integrated. As in the previous section, equilibrium prices are $P_1^* = P_2^* = a/(2b-d)$, equilibrium outputs are $q_1^* = q_2^* = ba/(2b-d)$, and, as in (5), each firm earns $\pi_D^{o*} = a^2 b/(2b-d)^2$. If D2 and U2 do not merge, however, then U2 charges D2 a price c_2 (still to be determined) and the sum of the unmerged firms' profits is then:

$\pi^S \equiv (P_2*-c_2)q_2* + c_2 \cdot q_2* = P_2*q_2$, or

(6) $\pi^S = b[a(2b+d)+2b^2c_2+bdc_1][a(2b+d)-c_2(2b^2-d^2)+bdc_1]/(4b^2-d^2)^2$,

where the "S" denotes "stand-alone". D2 and U2 therefore choose to merge if and only if $\pi_D^{o}* > \pi^S$.

We are now in a position to analyze the second stage of the game, the setting of input prices by U1 and U2. If both firms have merged vertically, or neither firm has, both D1 and D2 face input prices of zero. Thus, the only substantive case is that in which only D1 has merged vertically.

Here we have three scenarios to consider. In the first, firm 1 and U2 simultaneously choose the input prices to charge D2. As before we denote U2's price by c_2. We introduce the notation c_{12} for the price that firm 1 charges D2, reserving the notation c_1 for the internal transfer price in firm 1. For any price $c_2>0$ that U2 charges, firm 1 has an incentive to undercut that price slightly. In doing so, it has a negligible effect on ultimate downstream competition and yet makes a profit on its sales to D2. U2 has the usual Bertrand incentive to undercut c_{12}. The result is that $c_{12}=c_2=0$.

In the second scenario, firm 1 commits not to supply D2. If U2 is unconstrained in its pricing, it sets the "monopoly" price c_2^m calculated in the previous section. If there is a substitute product available at a price $\underline{c}<c_2^m$, U2 will undercut that price by an arbitrarily small amount (which we ignore) so that $c_2=\underline{c}$.

U2's power over price which results from the D1-U1 merger and U1's commitment not to supply D2 is the potential source of D1's advantage from the merger. However, as we discuss below, it is not necessarily in D1's interests for U2 to be endowed with this much power over price. In scenario (iii), D1 has the more fortunate position of being able to precisely tailor U2's power over price by

offering to supply D2. If it sets an offer price below U2's monopoly price, U2's best-response will be to undercut D1's price by an arbitrarily small amount. Thus, in essence, D1 sets the price of D2's input (up to a maximum equal to U2's monopoly price).

But what price does D1 want U2 to charge D2? On the one hand, as mentioned above, D1 prefers D2 to face higher input prices. On the other hand, if the price that D2 faces from U2 is "too high", that will give D2 and U2 an incentive to merge. This can be seen as follows: $d\pi^S/dc_2 = b\{d^2[a(2b+d)+bdc_1]-4b^2(2b^2-d^2)c_2\}/(4b^2-d^2)^2$. Thus, as shown in Figure 1, holding c_1 fixed at zero, π^S is decreasing in c_2 for c_2 sufficiently large. If c_2 is greater than c' in the figure, the sum of D2 and U2's profits is lower if they are unmerged than if they are merged (where they earn profits of π_D^{O*}). To calculate c', we equate (5) and (6) which yields:

(7) $c'=a(2b+d)d^2/2b^2[2b^2-d^2]$.

Importantly, $c_2^m=a(2b+d)/2(2b^2-d^2)>c'$ since b>d.

Although U2 and D2 find merger unprofitable if c_2 is low, this changes if c_2 becomes sufficiently large. The reasons for this are discussed in some detail in the following section. In short, the intuition is the following: A small increase in c_2 leads to an increase in both P_1 and P_2. Because prices are "too low" (from the downstream firms' point of view) at the initial Nash equilibrium, this increases profitability. In particular, D2 would be better off except for the fact that it must pay more for the relevant input. Since this payment is captured by U2, in sum D2 and U2 make higher profits. If c_2 increases "too much", however, D2's equilibrium price becomes higher than it wants, even if it has a zero input price. Thus if firm 1 attempts to be too "greedy" by charging a price to D2 for the input that is "too" high, it precipitates a merger between D2 and U2 that reduces D2's input price to zero,
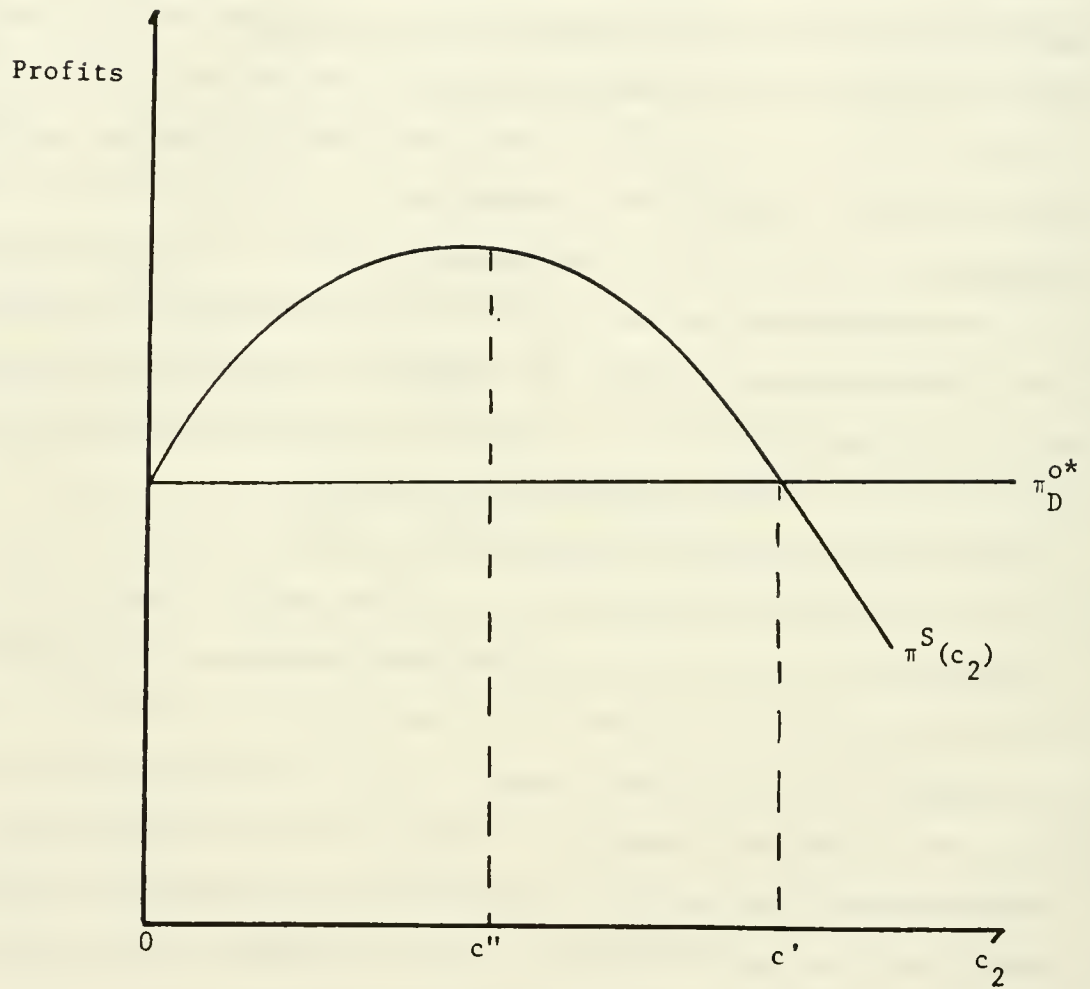
Figure 1: The Sum of Profits of the Foreclosed Firm and Its Supplier

making firm 1 worse off.

The optimal c_2 from firm 1's point of view therefore is as high as possible while not making merger profitable for D2, i.e., c'. In the third scenario, therefore, where firm 1 announces c_{12} before U2 announces c_2, firm 1 charges c'. U2 then undercuts this price by an arbitrarily small amount (which we ignore), so that $c_2 = c'$.

To summarize the second stage: If U2 and firm 1 simultaneously set prices (scenario (i)), then $c_2^* = 0$. If firm 1 can commit not to supply D2 (scenario(ii)), then $c_2^* = \min\{c, c_2^m\}$. If firm 1 can place an upper bound on the price that U2 charges D2 by standing ready to supply D2 at a price of firm 1's choosing (scenario (iii)), then $c_2^* = c'$.

We now consider the initial bidding stage. In principle, there are numerous ways in which one could formulate this stage. Bidding could be initiated either by upstream or downstream firms. A bidder could bid for only one firm at a time or it could make offers to more than one target. Alternatively, each firm could be paired with a single target. We first examine the simplest case which is where both downstream firms are required to bid for a particular upstream firm, say U1. We examine the robustness of the results to this assumption in the following section.[13]

We now compare the payoffs from winning versus losing this initial bidding contest. To be consistent with our notation above, we suppose that D1 is the winning bidder. If the input price to D2 that emerges from the second stage is $c_2^* > c'$, then D2 will merge with U2. The first merger will thus have no effect at all on the downstream equilibrium outcome. Accordingly, D1 will not bid a positive amount for U1 in this case.

If, on the other hand, the outcome of the second stage is

$c_2^* \leq c'$, D2 will not find it profitable to merge with U2. In that case the downstream division of firm 1, the former D1, earns

(8) $\pi_{D1}^* = b[a(2b+d) + bdc_2]^2 / (4b^2-d^2)^2$.

and D2 earns

(9) $\pi_{D2}^* = b[a(2b+d) - c_2(2b^2-d^2)]^2 / (4b^2-d^2)^2$.

The value of being the winning bidder is then $V \equiv \pi_{D1}^* - \pi_{D2}^*$. Rearranging, $V(c_2) = c_2 b(b+d)(2a-(b-d)c_2)/(4b^2-d^2)$. Since $a > b-d$, V is positive. Since V is the value that either downstream firm would be willing to pay to acquire U1, in equilibrium both bid this value. Given the assumed structure of the remainder of the game, U1 earns zero if it does not accept the offer and so it accepts one of the identical offers of $V > 0$.[14] Similarly, it would never pay D2 to bribe U1 to reject D1's bid and remain independent.[15]

The unique equilibrium to the four-stage game can therefore be summarized as follows:

If U2 and firm 1 simultaneously set prices at stage 2 so that $c_2^* = 0$, or if firm 1 only can commit not to supply D2 but cannot also constrain the price that U2 charges and there is no substitute input available at a price below c', so that $c2^* > c'$, then no vertical merger takes place.

If firm 1 can commit not to supply D2 and there is a substitute available at a price $\underline{c} < c'$, then both downstream firms offer $V(\underline{c})$ to purchase U1. U1 accepts one of these offers, say D1's. U2 undercuts c by an arbitrarily small amount. The firms then compete in prices with D1 facing a cost of zero and D2 a unit cost of $\underline{c}$.

If there is no substitute product but firm 1 can commit to the price at which it will supply D2, then both downstream firms offer $V(c')$ to purchase U1. The equilibrium is then as in the preceding case with c' instead of $\underline{c}$.

In equilibrium, therefore, provided the effect of firm 1's merger is not to raise the input price to D2 "too much", vertical foreclosure is rational and effective.

It is immediate from (3) that consumers are worse off if a vertical merger takes place since the prices of both final goods prices rise. Social welfare as measured by the sum of consumer surplus and profits also is lower.

Comparing (5) and (9) it is clear that D2 is made worse off as a result of the merger. More suprising, perhaps, former D1 is also worse off: its net payoff is the same as D2's in this symmetric game. Its gross profits are increased by the merger, of course. However, because it paid V to acquire U1 its net profits are lower than they would have been had there been no vertical merger: both downstream firms would be better off if the bidding war was never started - if publicly traded, their stock prices both fall when the bidding commences! The game has a prisoners' dilemma structure to it: Any firm that believes that the other will not bid for U1 can gain by buying up U1 at a low price and capturing the rents from the foreclosure of its rival. The fear of being foreclosed drives each to attempt to foreclose the other. This, however, is largely a result of the perfect symmetry of the model and of the fact that the upstream firms have all the bargaining power. In a richer model with asymmetric downstream payoffs or a more even division of bargaining power, the foreclosing firm also could be made better off in equilibrium.

Both U1 and U2 are better off than in the absence of the takeover. U1 is made better off by the amount of the takeover price, V, while U2 earns profits of π_{U2}^*. Note that U1 is better off than U2. This can be seen as follows: In sum, U1 and D1 earn

more than U2 and D2 (by virtue of the foreclosure effect on D2).
However D1 and D2 earn the same profits; thus U1 must do better than
U2.[16] This is an attractive feature of the model because there will
be no holdout problem upstream: U1 has no incentive to reject the
merger. Instead, it welcomes the fact that it is the target.

In order to obtain clearer intuition for the results, we now
provide a diagrammatic analysis. Figure 2 illustrates D1's and D2's
best-response functions when they have common marginal costs equal
to zero. (Notice that the figure is drawn with an arbitrary upward-
sloping best-response function, showing that the above analysis does
not hinge on the assumed linearity of demand.) The Bertrand-Nash
equilibrium is at B. D2's isoprofit curve at that equilibrium is
also drawn. Since this isoprofit curve corresponds to $c_2=0$, this
also is its isorevenue curve. Now consider what happens when c_2
rises. The equilibrium outcome moves along D1's best-response
function in the direction of A. The critical feature of the model
is that in the neighborhood of B, in particular between B and D,
D2's revenue is higher than at B. Put differently, as one moves
along firm 1's best-response function, the prices of both firms rise
and, since they were lower than the firms would have liked in the
first place, both firms are made better off in the process.

In equilibrium, D2's costs do not remain unchanged, however.
Nonetheless, what is important for our analysis is the effect on the
combined profits of D2 and U2. Note that that combined firm has
zero marginal costs. Therefore the combined firm's profit is the
same as D2's revenue in the initial pre-merger situation
(illustrated in Figure 2). Thus, locally, the combined profits of
D2 and U2 rise as c_2 rises.[17] In this region, since D2 and U2 are
jointly more profitable if they remain separate, it is impossible
for D2 to make an offer to purchase U2 that U2 will accept and that
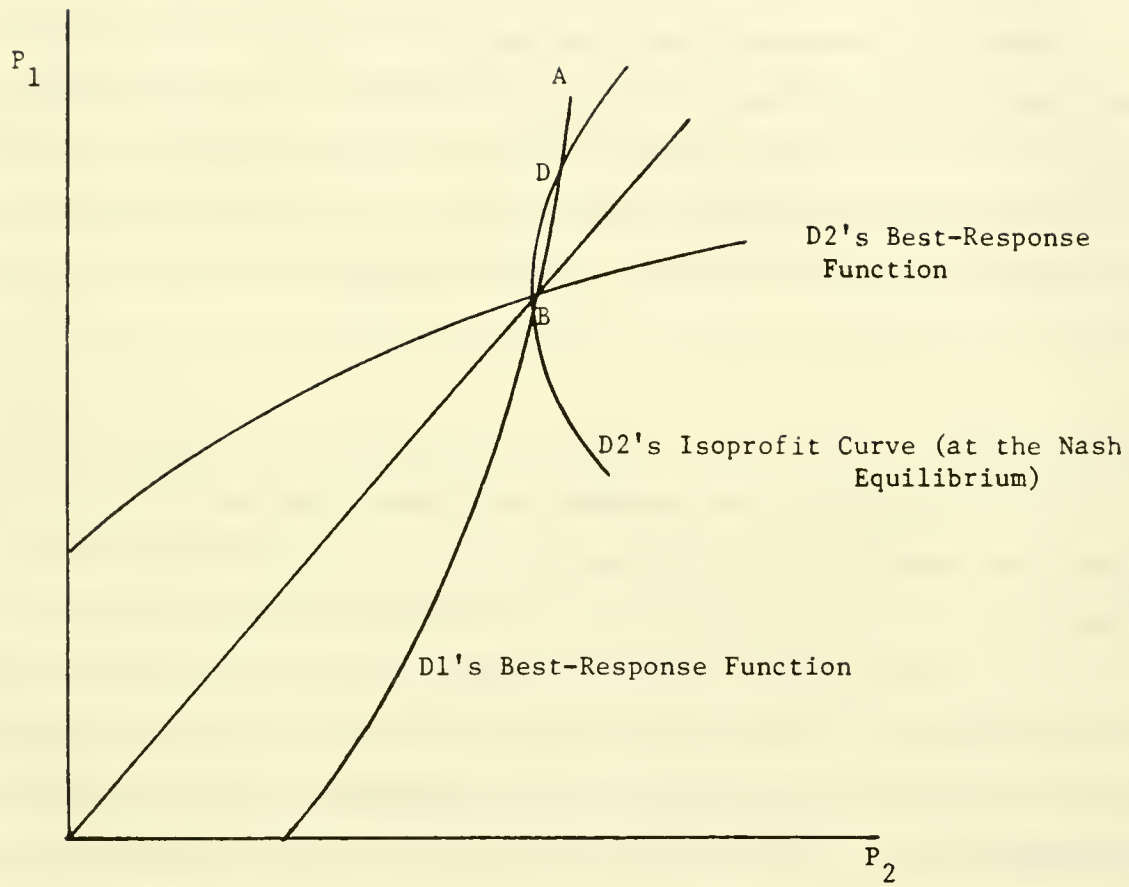
Figure 2: Best-Response Functions with Price as the Strategic Variable

would also be worthwhile for D2. Notice that this is only true in the region BD. Once c_2 becomes sufficiently high (beyond c') the equilibrium price that D2 charges is so high that its equilibrium output falls off to the extent that it prefers the old equilibrium point B. If $c_2 > c'$, therefore, U2 and D2 will have a combined incentive to counter the effects of the D1-U1 merger by merging themselves.

The final step of the diagrammatic analysis is to observe which price D1 would like D2 to pay for the input. D1's profits are increasing in the direction of A along its best-response function. It therefore wants a price charged that is as high as possible while not inducing D2 and U2 to merge. This is point D (where c_2 is equal to c').

4. Robustness

In this section we examine the robustness of the results of the previous section with respect to four fundamental changes in the assumptions. First, we investigate the possibility that the downstream firms can make offers to either of the upstream firms. Second, we examine the equilibrium outcomes when the upstream firms bid for downstream firms rather than vice versa. Third, we replace the assumption of differentiated products and price competition with one of homogeneous goods and quantity competition. Finally, we allow for downstream two-part tariffs for inputs in lieu of vertical integration.

(i) Offers to Either Upstream Firm

The assumption that D1 and D2 are both required to bid for U1 at the first stage may seem somewhat restrictive. Suppose instead that D1 and D2 can each make an offer to whichever upstream firm they choose. It turns out that the equilibria analyzed in the

previous section are unaffected by this change.

Recall that the equilibrium calls for both D1 and D2 to offer $V(c_2)$ to U1 and for U1 to accept this offer. If the downstream firms can make an offer to either of the upstream firms, D2 has no incentive to deviate by offering a higher price to U1. But does it have an incentive to deviate by making an offer to U2? If U2 maintains its equilibrium path beliefs and expects U1 to accept D1's offer, then the analysis is exactly the same as before. If U2 does not accept D2's offer it expects to be able to charge c_2* in the second stage, where c_2* depends on the scenario under consideration. If the sum of U2's and D2's profits is higher if U2 does not merge with D2 at stage 3 than if it does, it is not possible for D2 to make U2 an offer that would make them both better off.[18]

(ii) Offers by the Upstream Firms

A more substantial change involves considering the upstream firms bidding for the downstream firms, rather than vice versa. For example, consider replacing the first stage with simultaneous offers by the U's for D1, and modify the third stage analogously so that an unmerged U has an opportunity to counter the effect of a merger by buying D2. As we discuss below, with this formulation it is possible that a holdout problem arises, unlike when the downstream firms do the bidding.

When the holdout problem does not arise, the only effect of this change in the game formulation is to reallocate the rents: the basic outcome of the game remains unchanged, however. Indeed if U1 (say) purchases D1 in the first stage, the rest of the analysis remains as before. The only change is in the amounts that are bid in stage 1 and the resulting profits.

To see how a holdout problem might arise, consider scenario

(iii). The upstream firm that succeeds in buying D1 earns $\pi_{D1}*$ (as calculated in (8)). The upstream firm that loses the bidding contest earns $\pi_{U2}*$. In order to induce D1 to sell out, D1 must be offered at least π_D^O*. The winning firm therefore earns at most $\pi_{D1}* - \pi_D^O*$. Thus the upstream firm prefers winning to losing if and only if:

$$\pi_{D1}* - \pi_{U2}* > \pi_D^O*.$$

Rewriting, this condition becomes:

$$(a(2b+d)+bdc_2*)^2\alpha - c_2*(a(2b+d)-c_2*(2b^2-d^2))\alpha > a^2(2b+d)^2\alpha$$

where $\alpha \equiv b/(4b^2-d^2)$. Rearranging yields the condition:

$$a(2b+d)(2bd-1)+c_2*(2b^2+b^2d^2-d^2)>0.$$

Since this is increasing in c_2, it is necessary that this condition hold for $c_2=c'$. Substituting for c' and rearranging gives:

(10) $2b^2(2b^2-d^2)(2bd-1)+d^2(2b^2-b^2d^2-d^2) > 0.$

When (10) holds, the outcome is very similar to that discussed in the previous section. Both U1 and U2 bid $\pi_{D1}*-\pi_{U2}*$ (since they are both keen to win the bidding) and D1 accepts one of the offers. The value to D1 of the merger (compared with the stand-alone case) is $\pi_{D1}*-\pi_{U2}*-\pi_D^O*$. As before, D2 earns $\pi_{D2}*$.

Condition (10) fails to hold if d is small. The intuition is the following: If d is small there is little substitutability between the downstream products: each downstream firm has a virtual monopoly. There is thus little to be gained from disadvantaging the rival but a great deal to be gained from becoming a monopoly supplier to a virtual downstream monopolist. While a holdout problem might arise if d is small, because there is little rivalry between the downstream firms in this case, the incentive for foreclosure is correspondingly small. Thus the case of interest from the point of view of anticompetitive behavior is where d is large, in which case the holdout problem does not arise.

When (10) fails to hold, there are still equilibria to the four stage games, but they are not terribly satisfactory. For example, where the U's are bidding for the D's, there is an equilibrium in which one of the U's, say U1, is the "nominated bidder" for D1. It bids π_D^{O*} (plus an arbitrarily small amount) and earns the difference between $\pi_{D1}*$ and its bid, which is, however, less than the $\pi_{U2}*$ that its rival earns.

The reason that the holdout problem arises in this setting but not in the case where the D's do the bidding is the following: In the case where the U's bid for one of the D's, the latter is endowed with all of the bargaining power. In order to be induced to merge it must be made at least as well off as in the case where there are no vertical mergers, i.e. it must earn at least π_D^{O*}. In the case where the D's do the bidding, however, each D knows that it will earn only $\pi_{D2}*$ ($<\pi_D^{O*}$) if it loses. Accordingly it is more keen to integrate or, put differently, it's "threat" point is lower. While, as we showed in Section 3, it is always the case that $\pi_{D1}*-\pi_{U2}*$ exceeds $\pi_{D2}*$, it need not exceed π_D^{O*}.

(iii) Homogeneous Goods and Quantity Competition

We now consider what happens when we replace the differentiated products price-setting model with a homogeneous product, quantity setting model. In this case there is an incentive for U2 and D2 to make a counter merger, eliminating the incentive for D1 and U1 to merge.

With linear demand, $P=a-bq_1-bq_2$, Di's best-response function is given by $q_i=(a-bq_j-c_i)/2b$, equilibrium outputs are $q_i*=(a-2c_i+c_j)/3b$, and equilibrium profits are $(a-2c_i+c_j)^2/9b$ $(i,j=1,2)$.

Now suppose that D1 has merged with U1, and consider the incentive of D2 and U2 to merge. If they merge, thereby reducing

D2's input costs to zero, their combined profits are $a^2/9b$. If they don't merge, on the other hand, they earn $P*q_2*=(a^2-ac_2-2c_2^2)/9b$. This is less than their profits if they merge, $a^2/9b$, for any $c_2>0$. In the homogeneous goods Cournot case, therefore, if D1 merges with U1, D2 and U2 will always have an incentive to counter the effect of the vertical merger by merging themselves. Anticipating this counter merger, D1 will have no incentive to acquire U1.

To see this graphically, consider Figure 3. Starting from the Cournot-Nash equilibrium at C, any movement along D1's best-response function would make D2 worse off, even if its costs did not change. Thus the combined profits of D2 and U2 fall as c_2 rise. As a result, D2 and U2 would indeed be willing to counter the effects of a merger by D1 with U1.

It is by now commonplace to observe that oligopoly models are sensitive to the strategic variable under consideration. This sensitivity can, as usual, be explained in terms of the "strategic complements and substitutes" taxonomy of Bulow, Geanakoplos, and Klemperer (1985).[19] In price-setting games, an increase in one firms's price induces the rival to raise its own, an effect that the former desires. Thus, prices are strategic complements. Conversely, a decrease in output induces the rival to expand, an unattractive outcome for the former: outputs are strategic substitutes. If one conceptualizes Di and Ui as a unit (whether they are in fact merged or not), then one sees that where price is the strategic variable, firm 1's merger can create value for the combined D2-U2 rival, whereas when quantity is the strategic variable, the combined rival is always made worse off. Thus in the former case, there may not be a combined incentive to counter the effect of the merger.
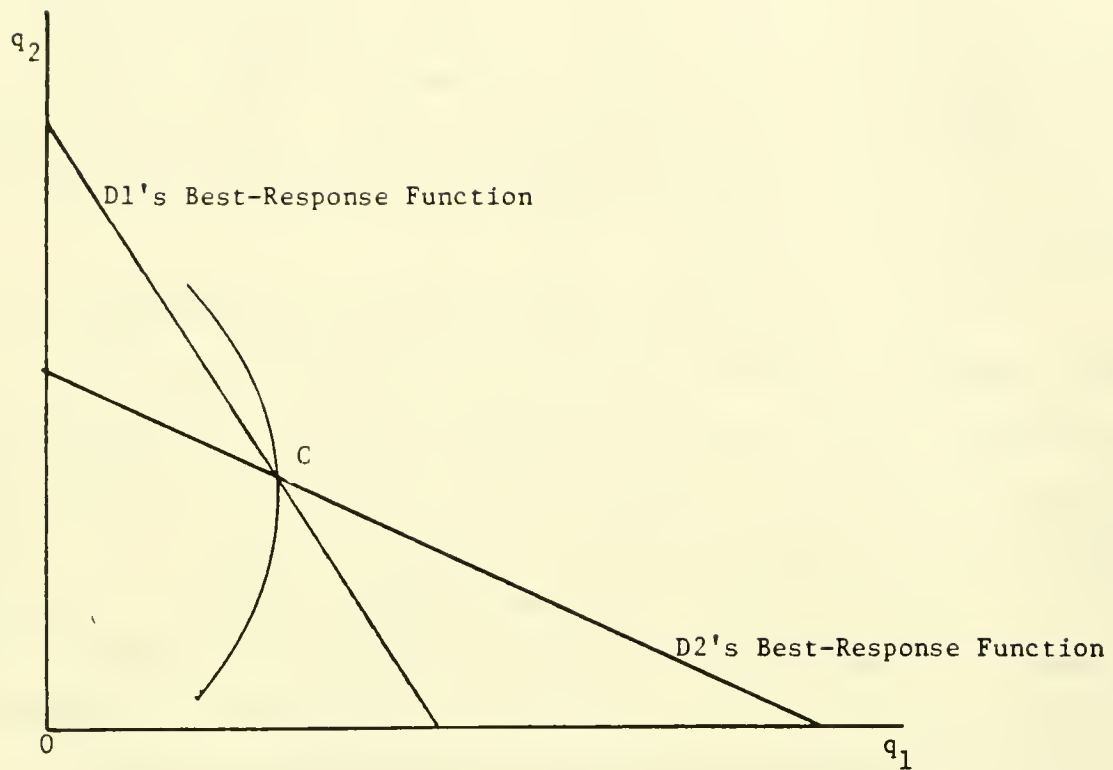
Figure 3: Best-Response Functions with Quantities as the Strategic Variables

(iv) Two-Part Tariffs and Transfer Pricing at Stage 3

Vertical merger constitutes an extreme way in which vertical relationships can be restructured. Where it is possible for firms to enter into alternative binding contracts, these may sometimes be preferable. We abstract from the issues of which contractual form can be implemented in practice and simply explore the effect on equilibrium of some alternative contractual forms. In the conclusion to this section we remark on the informational and contractual assumptions that underlie the different vertical relationships we consider.

To see why U2 and D2 may prefer alternative contractual forms, consider the case where $c_2*=c'$. In that case, it is clear from Figure 1 that a vertical merger is not the most profitable outcome for D2 and U2 taken as a unit. The most profitable outcome emerges when U2 charges a price of c'' ($< c'$) to D2.

To take advantage of these potential gains, D2 can induce U2 to charge c'' rather than c' by offering a suitable lump-sum payment. The resulting optimal contract can be implemented as a two-part tariff. More generally, it may be possible for U2 and D2 to implement this outcome even if they vertically integrate. This is possible if the merged firm 2 can commit to a transfer price at which (the old) U2 will supply (the old) D2. In that case, by setting the transfer price at c'', firm 2 achieves the same outcome as U2 and D2 achieve at arms' length with a two-part tariff.

The effect of U2 charging a price of c'' is illustrated in Figure 4. Several things are immediate from the figure. First, even when D2 and U2 respond with an optimal contract, firm 1's vertical merger still makes it better off. Second, taken together, U2 and D2 also gain. This results from the fact that, as discussed earlier, where prices are strategic complements, the firms prefer higher
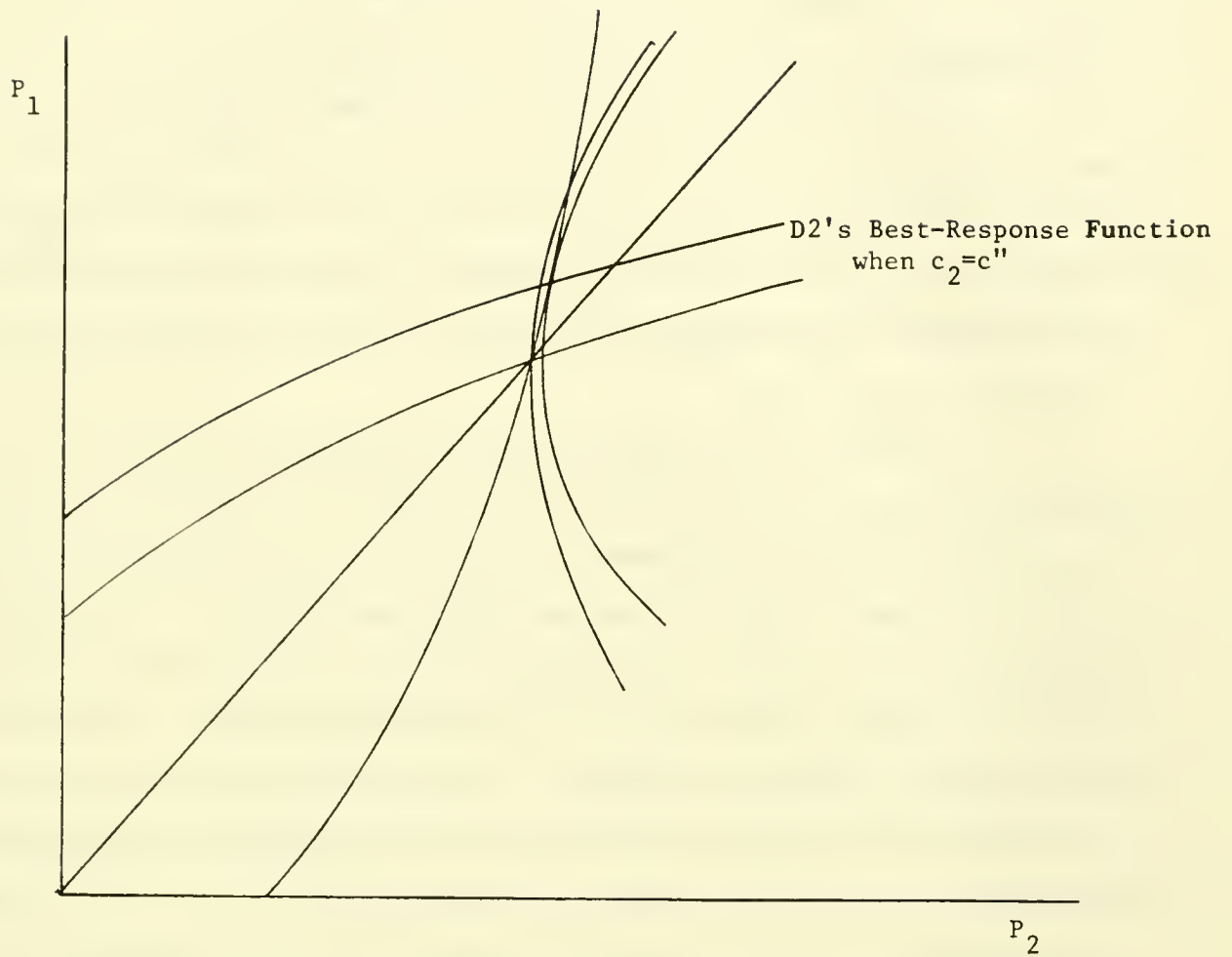
Figure 4: Equilibrium when U2 and D2 Respond with Optimal Contract

prices, and such higher prices emerge when input costs rise. The outcome for D2 and U2 individually depends on how these rents are divided in the bargaining between them.[20]

(v) Two-Part Tariffs and Transfer Pricing at Stage 1

In this subsection we return to the case where D2 contemplates vertical integration at stage 3 (as in Section 3). We now consider what happens if D1 and D2 bid with two-part tariffs in the original bidding for U1. Here the analysis is less clean than in the case of vertical integration. In particular, multiple equilibria may arise.

To see this, we concentrate on scenario (iii) in which, in the second stage, U1 announces c_{12} before U2 announces c_2. Now consider a proposed equilibrium to the four stage game in which $f>0$, $c_1=0$, and $c_2=c'$, where f is the fixed fee. Such a contract would replicate the vertical integration foreclosure of the previous section. While this is still an equilibrium here, it is no longer the unique equilibrium, however. To see this, notice that once U1 has received the fixed fee of f, it has no incentive to maintain an elevated price to D2. Indeed it knows that no matter what price it charges D2, that price will be undercut by U2. Although U1 realizes the effect that this will have on downstream profits, since its own profits do not depend on that, it is indifferent to the various prices it can charge D2. If D1 believes that U1 will charge a price of zero to D2 (in "bad faith") it will be unwilling to bid any $f>0$. There is thus an equilibrium in which $f=c_1=0$, producing the no-integration outcome.

Which of these equilibria is the more "compelling"? We argue that it is the one just described in which it is not possible to implement a two-part tariff that results in foreclosure. To see why, consider the other scenario in which foreclosure effected by

vertical integration is anticompetitive, namely scenario (ii) with a competitive fringe supplying at a price of $\underline{c} \leq c'$. In the case of vertical integration we make the (natural) assumption that D1 can prevent its upstream division from supplying D2. If the vertical contract does not constrain U1 from supplying D2, it will have an incentive to compete with U2 for D2's business. If U1 and U2 are on an equal footing in this competition, modelled by assuming that U1 and U2 move simultaneously, then c_2 is driven to zero. In that case D1 and D2 have no incentive to bid for the initial two-part tariff contract with U1.

The point of both of these cases is that vertical integration provides D1 with control over the price that U1 charges both D1 _and_ D2. Both of these instruments are necessary to implement the foreclosure. In a simple two-part tariff, the second of these instruments - control over U1's price to D2 - is lacking. In order for a vertical contract to replicate integration, it must also control U1's pricing to D2. In the case where $c_2^m < c'$, so that there is no need for D1 to keep c_2 down, coupling the two-part tariff with an exclusivity clause (requiring that U1 supply only D1) will be sufficient to replicate integration. In the case of scenario (iii), however, where D1 has to "fine tune" c_2, the two-part tariff would have to be coupled with a clause stipulating the price U2 must charge D2.

(vi) Simultaneous Competition in Two-Part Tariffs or Transfer Prices

As we saw in subsection (iv), if one of the downstream firms enters into a vertical contract (integration or otherwise) with a supplier, it is in the interests of the other to enter into a two-part tariff contract or vertical-integration-cum-transfer-pricing with the remaining supplier. Importantly, this is not the case when the second firm can only respond with vertical integration coupled

with internal marginal cost pricing. Thus, while it makes sense to consider sequential moves in order to consider counterstrategies in the case of vertical integration, if both firms can negotiate two-part tariffs or above-cost transfer pricing, it makes most sense to consider the simultaneous move case. To do otherwise confers a first-mover advantage on one of the firms.

The analysis of the case in which the firms simultaneously set transfer prices is similar to that of Fershtman and Judd (1987). They examine the incentives firms have to distort the compensation schedules their managers face in order to change their conduct in the product markets. Our analysis of the simultaneous move transfer pricing case is presented only for completeness. As we discuss at greater length in the conclusion to this section, the assumption that the firms can commit to such transfer prices is an extremely strong one.

For any possible best-response function of D1, there is a most preferred outcome on that function for D2. D2 can implement that outcome by appropriate choice of its transfer price. In Figure 5, the locus of such "most preferred points" for D2, as D1's best-response function varies, is graphed as XY. The equilibrium final goods prices must lie on that locus if D2 is behaving optimally. Further, in the symmetric simultaneous move case the firms must charge equal prices. The equilibrium prices are therefore those designated as Z in the figure.

Several conclusions flow immediately from the figure: (i) The equilibrium prices are higher than when the firms face zero marginal costs; (ii) the firms earn higher profits, but consumers are worse off; and (iii) equilibrium prices are lower than if the firms could collude perfectly (the shaded area represents mutually preferred prices).
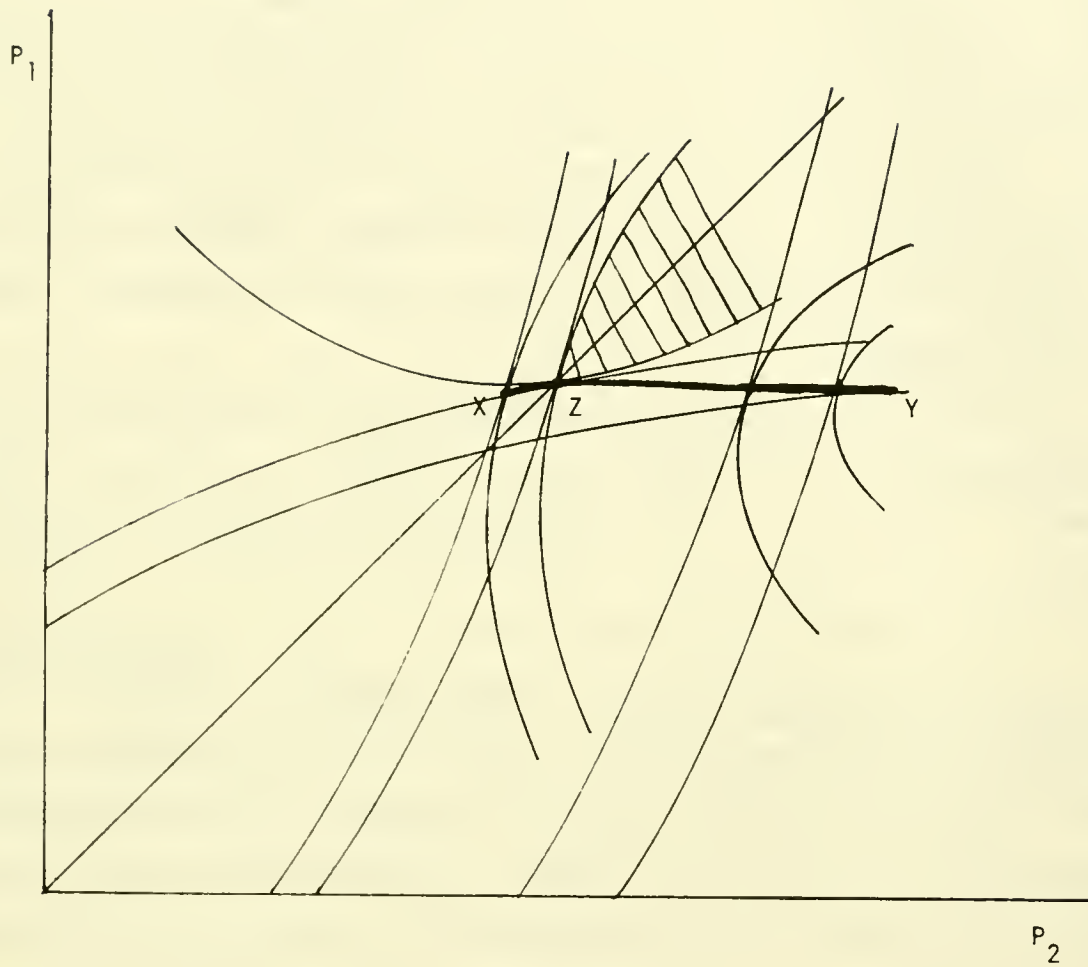
Figure 5: Two-Part Tariff or Transfer Pricing Equilibrium

(vii) Concluding Comments on Vertical Contracts

In some sense (in our setting) vertical integration is just a special form of two-part tariff; i.e., where the price is equal to marginal cost and the fee is the purchase price. Yet, as we have seen, other two-part tariffs in which a higher unit price and lower fixed fee are charged may be mutually beneficial to the contracting party. This occurs in the case of differentiated products price competition because, given the best-response function of its rival, the equilibrium revenue of the firm is (locally) higher if its input costs are higher.

However, a two-part tariff between unintegrated firms may not be the only way of effecting an increase in marginal input prices. Indeed, if an integrated firm can commit to an internal transfer price above marginal cost, this can have the same effect.

The question therefore reduces to one of identifying the factors that determine which of these potential vertical contracts is feasible in a given setting. We are able to identify several of these. First, in order to effect foreclosure, the foreclosing downstream firm may need not only to secure control over the price which it is charged by its supplier, but also secure control over the price which its supplier charges to its downstream rival. while that is eminently plausible in the case of full vertical integration, it may be less plausible, for antitrust reasons, in the case of a vertical contract.

Second, in order for a firm to use a transfer price or a two-part tariff to increase the input price it faces, it is necessary that the contracting firms be able to credibly commit to that higher price. Absent such commitment, the contracting firms would have an incentive to secretly renegotiate their agreement, lowering the actual input price the downstream firm faces in

exchange for a fixed payment to the upstream firm. Put differently, the contracting firms could "pretend" to agree to a high input price in order to induce the downstream rival to raise its own final goods price. Once that is achieved, they have an incentive to "cheat" on this facilitating practice by "secretly" lowering the input price. This lowers the cheating downstream firm's final goods price and increases its sales at the expense of its downstream rival. How to achieve this commitment is itself an interesting issue. As in Salop (1986), it actually may be easier to achieve such commitment with a two-part tariff rather than with an internal transfer price. In particular, it may be possible to couple the two-part tariff with a most favored nation clause to other buyers who then would have the incentive to police the agreement.

5. Conclusions

We have investigated how vertical integration can be used to achieve anticompetitive foreclosure of downstream firms from an essential source of supply. Our main conclusion is that anticompetitive foreclosure arises as an equilibrium phenomenon in a coherent model where sophisticated firms use a wide range of strategies and counterstrategies.

Our analysis indicates that the profitability of foreclosure involves a number of subtleties. However these subtleties are not those associated with the standard critique of foreclosure theory discussed in the introduction. Indeed, the central condition for successful foreclosure is simply that the unintegrated upstream firm's gain exceed the downstream firm's loss.

This condition can be satisfied in a model with differentiated products and price-setting because the sum of the profits of the foreclosed firm and its supplier increase (locally)

if the foreclosed firm's price rises (and the rival's price adjusts optimally). In a quantity-setting, homogeneous goods model, by contrast, the sum of those profits decrease if the foreclosed firm's output decreases and the rival's adjusts optimally.

Even in the differentiated products case, the sum of the unintegrated firms' profits are reduced if the unintegrated upstream firm's market power is "too" great. This is because, in that case, the profit-maximizing price that it charges for its input will be so high that the downstream firm will have the incentive and ability to offer a mutually beneficial vertical merger. In this paper we have set out two of the ways in which the unintegrated upstream firm's market power may be limited. One is that the integrated firm may be able to constrain the upstream spot price. The other is that there may be an alternative (and inferior) competitive source of supply.

As another alternative, one could model the upstream industry as an oligopoly rather than a duopoly. In that case, a single vertical merger would not confer complete monopoly power on the remaining upstream firms. While competition among them would naturally constrain the upstream price, reducing the profitability of foreclosure, such competition also would reduce the the potential for an effective counterstrategy on the part of the foreclosed downstream firm. The necessary modeling is not entirely straightforward, however. Since the interesting case is one in which the elimination of an upstream firm does have some effect on input prices, this requires specifying an upstream market in which the goods are at least somewhat differentiated (perhaps because of transportation costs). Enriching the model in this way is a possible avenue for future research.

The controversy surrounding the vertical foreclosure argument has traditionally been cast in the context of vertical

integration. In order to address the questions raised in that debate we have, for the most part, kept to that formulation. Yet, as modern contract theory emphasizes, vertical integration is but one particular form of vertical contract. Indeed, as we have shown, there may exist incentives for firms to structure vertical relationships in ways that fall short of full vertical integration if they are so able. This richer formulation raises a number of interesting issues that we have only begun to explore.

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FOOTNOTES

1.   The other main strand of the debate concerns how vertical
mergers can eliminate inefficiencies due to a double markup of input
costs and substitution to other less efficient inputs. Similar
models show how vertical mergers can be used to facilitate price
discrimination against purchasers with less elastic demands. On the
question of double marginalization see, for example, Spengler (1950)
and Dixit (1983). The issue of input substitution has been examined
by, inter alia, Vernon and Graham (1971), Schmalensee (1973), and
Warren-Boulton (1974). For a discussion of price discrimination
issues in vertical integration see Perry and Groff (1983) and the
references cited therein.

2.   See, for example, Brown Shoe Co. v. United States, 370 US 294
(1962) and United States v. Aluminum Co. of America, 44 F. Supp. 97,
121-44 (SDNY 1941).

3.   For example, the Department of Justice's 1984 Vertical Merger
Guidelines.

4.   See Bork (1978) 222-245 and 299-309, Posner (1976) 171-84, 196-
207, Easterbrook (1984), and Posner and Easterbrook (1981), 869-876.

5.   In what follows we focus on foreclosure of downstream rivals.
The analysis of foreclosure of upstream rivals is analogous.

6.   For a general discussion of potential anticompetitive
consequences of vertical mergers see Krattenmaker and Salop (1986).

7.   Krattenmaker and Salop term this version of the vertical
foreclosure theory the "Frankenstein Monster" because the integrated
downstream firm creates market power for the remaining upstream
firms, giving them the power to raise input prices to its rival.

8.   This fixed proportions assumption is also useful because the
critics of foreclosure usually analyze this case.

9.   See Rey and Tirole (1986) and Tirole (1987, Chapter 4) for an outstanding presentation of vertical restraints, and the references cited in both for other papers in this literature. Also, Aghion and Bolton (1987) provide an interesting analysis of the case in which the exclusionary contract is written in advance of the actual entry of the rival for the purposes of deterring that entry. This is achieved by writing a liquidated damages contract.

10   By contrast, Comanor and Frech (1985) and Schwartz (1987) assume that there is a dominant firm which has a first-mover advantage in that it can make an offer of exclusive dealership to distributors before the competitive fringe can do so.

11   In this case, if the firms were vertically integrated and they were somehow able to collude on the levels of their internal transfer prices, they would choose a transfer price above marginal costs. See Salop and Scheffman (1987) for the case in which a dominant firm is willing to bring about an increase in industry input costs. This occurs in their model because the disadvantage to the rival leads to an increase in industry price that more than offsets the losses to the dominant firm of higher input costs.

12.   While it may in general be in the interests of one of the downstream firms to acquire a monopoly of the upstream supply by acquiring both U1 and U2, such an action typically would be prohibited by antitrust laws against horizontal mergers. Accordingly we assume that such an action is not possible.

13.   For the moment we defend it by noting that it is a natural assumption in the context of the phenomenon we are studying. Recall that a major point of the paper is to examine the possibility of effecting anticompetitive vertical foreclosure in a market where the rival uses the counterstrategies at its disposal. One such

counterstrategy is initially outbidding the foreclosing downstream
firm for the target upstream firm. Thus a natural starting point is
to assume open bidding for the upstream target.

14.   In this formulation, the indeterminacy in who wins the bidding
is entirely due to the perfect symmetry between the downstream
firms. More generally, the values to winning and losing will be
different for D1 and D2 if their other input costs differ or if
their product demands are not perfectly symmetric. In general, the
firm for which the difference between its profits when it wins
versus those when it loses the bidding is the highest will win the
bidding contest. Moreover, it will pay an amount equal to the
rival's difference between winning and losing.

15.   D2's potential strategy of bribing U1 not to enter into a
vertical merger with D1 (if it were possible and legal to make such
a bribe) would always be dominated by outbidding U1. In the former
case the firms remain at the status quo, earning π_D^O*. Since a
successful bribe would have to exceed V and since $\pi_D^O*-V<\pi_{D1}*-V$,
merger is preferable to a bribe.

16. Algebraically this can be seen as follows: $\pi_{U2}*=\pi^S*-\pi_{D2}*$, by
definition. Further, in equilibrium $\pi^S*=\pi_{DO}*$. Therefore $\pi_{U2}*=\pi_{DO}*-$
$\pi_{D2}*$. Since $V=\pi_{D1}*-\pi_{D2}*$ and $\pi_{D1}*>\pi_{DO}*$ (from (8)), this implies
that $V>\pi_{U2}*$: U1 makes higher profits than U2.

17.   This can also be seen directly from Figure 1.

18.   By assuming somewhat implausible beliefs, however, it is
possible to obtain other equilibria as well. Suppose that all the
firms expect that U1 will decline D1's offer if D2 makes an offer to
U2 (expecting U2 to accept D2's offer). Then it would indeed pay
for D2 to deviate in this way.

19.   This is also equivalent to the "the fat-cat effect" and "the

lean and hungry look" taxonomy developed by Fudenberg and Tirole (1984).

20   If, in the four stage model of the previous section we replace U2's offering a price to D2 on a take-it-or-leave-it basis with U2 offering a contract on that basis, then of course all the rents are captured by U2 and D2's position is as desired in that section. It is worse off after the merger.