Journal of Institutional and Theoretical Economics (JITE) 147 (1991), 207–226
Zeitschrift für die gesamte Staatswissenschaft

The "Foreclosure" Effects of Vertical Mergers*

by

PATRICK BOLTON and MICHAEL D. WHINSTON

1. Introduction

Antitrust law has long been concerned with the potential anticompetitive effects of vertical mergers. The foreclosure doctrine states that the main purpose of an acquisition of an upstream or downstream firm is to weaken the extent of competition in either market by foreclosing competitors from that part of the market taken by the acquired firm. This doctrine has been applied in a number of leading cases, among which *Brown Shoe Company vs. United States* is perhaps the most widely discussed. The Brown Shoe Company was manufacturing shoes and wanted to integrate with a shoe retailer. This merger was held illegal by the Supreme Court on the grounds that the share of the market represented by the acquired retailer was no longer accessible to competitors and that consequently the merger severely reduced competition.

The foreclosure doctrine has never been set on solid foundations and the early critics of the foreclosure argument deserve much credit for pointing out its logical flaws. One of the most systematic attacks of the foreclosure doctrine is given in BORK [1978]. He provides a detailed discussion of foreclosure in general and of the Brown Shoe case in particular, of which some of the salient points are:

- The acquiring firm would not wish to exclude rivals, for any possible benefit of this exclusion to the acquiring firm would be offset by a loss to the acquired firm. For example, if an upstream firm forces a retailer it has newly acquired to sell only its product and to stop carrying its rivals' less costly or more desirable product the gain in increased sales to the upstream firm is more than offset by the loss in profits to the retailer.
- If the object of the acquisition of a retailer is to capture the retailer's local monopoly rent and to prevent rival manufacturers from getting a share of that rent, then competition for final customers through price cutting will be replaced by competition for retailers.

* We would like to thank Mathias Dewatripont for his comments.

- Foreclosure theory is irrelevant; the only task for antitrust authorities is to avoid concentration in both the upstream and downstream markets. In that case vertical mergers cannot have any anticompetitive effects.

Bork concludes his discussion with the strong recommendation that so long as horizontal merger standards are met vertical mergers cannot have any anticompetitive effects; should be presumed to be based only on efficiency motives; and should therefore be permitted.

In an ingenious recent paper ORDOVER, SALONER and SALOP [1990] (*OSS*) take issue with this recommendation and show that it is possible to have strong anticompetitive effects as a result of a vertical merger. The key point in their analysis is to argue that when an upstream firm merges with a downstream firm, that upstream firm has lower incentives to engage in price-cutting competition with other upstream firms in order to serve non-integrated downstream firms. As a result, the rival upstream firms can charge higher prices for their inputs, other things being equal. This raises the costs of the unintegrated downstream sector. This increase in costs is then reflected in higher final goods prices, so that the integrated downstream firm can in turn raise its prices and make higher profits. The end result is that final goods prices have gone up, total producer's surplus has gone up and consumers are worse off.[1]

There are two crucial steps in the *OSS* argument. The first is to show that as a result of a vertical merger, competition on the input market can be reduced. *OSS* establish this by assuming that the vertically integrated firm can commit to compete less fiercely on the input market. Exactly how this commitment is achieved is not explained. The second step is to show that by committing to compete less fiercely the integrated firm induces the other upstream firm to raise its input price and thus to raise the marginal cost of the unintegrated downstream sector. Establishing this second proposition requires an important restriction on the set of feasible pricing-schemes that upstream firms can offer to downstream firms. Essentially only linear pricing is permitted and in particular two-part tariffs (where the input supplier charges a fixed fee and a unit price) are ruled out. Why such pricing-schemes are not permitted is left unexplained.

Motivated in part by these difficulties, two recent papers – HART and TIROLE [1990] and BOLTON and WHINSTON [1990] – have tried to shed further light on the vertical foreclosure story. While the two papers address different aspects of the vertical foreclosure issue, both take as their foundation a transaction costs approach to vertical integration in the tradition of WILLIAMSON [1985] and GROSSMAN and HART [1986]; thus, in these papers, integration matters because of the control changes it induces in a world of contractual incompleteness. The advantages of this approach are two-fold. First, the change in prices and trade

[1] Indeed, in the *OSS* model each of the criticisms of foreclosure theory described above fails to have force (for more on this see the discussion in *OSS*).

decisions which accompanies vertical integration is traced to a somewhat more fundamental source than is common in the literature on vertical integration. Second, and perhaps more importantly, greater focus is accorded to the incentive changes that integration may cause for previously independent managers. This permits these papers to simultaneously consider the competitive and the efficiency effects of the vertical mergers they analyze. Finally, the two studies also differ from *OSS* in allowing general trade agreements to arise (i.e., in not restricting attention to simple linear contracts).

The two papers differ in the type of vertical foreclosure effects they analyze. Hart and Tirole, like *OSS*, focus on the effects that a vertical merger can have on downstream competition. Their principal conclusion is that the foreclosure effect uncovered by *OSS* can indeed be an important anticompetitive consequence of vertical mergers even if one drops the two questionable assumptions made by *OSS*. In contrast, Bolton and Whinston focus on vertical foreclosure effects that arise in competition for inputs. They consider a setting in which downstream firms are concerned about supply assurance and demonstrate that vertical mergers may exacerbate the supply assurance problem faced by non-integrated firms. In both papers the incentive to engage in such mergers may be excessive from a social point of view.

In this paper, we seek to convey in as simple a setting as possible, the fundamental ideas of these two studies. In Section 2, we briefly outline the main building blocks of the two models. To facilitate the exposition we focus on a simple example that can illustrate the basic points in both of these papers. In Section 3, we analyze and discuss the effects of vertical mergers in each of the models. In Section 4, we extend this example to show how these types of foreclosure effects can give rise to waves of vertical integration, in which an initial integration decision by two firms can spark integration by others as a response. Finally, Section 5 contains concluding comments.

2. *Vertical Mergers in the Absence of Competition*

In this section we briefly outline a simplified version of the model of the firm based on contractual incompleteness and asset ownership that both Hart and Tirole (*HT*) and Bolton and Whinston (*BW*) share in common. The model presented here is a highly simplified version of both Hart and Tirole [1990] and Bolton and Whinston [1990] but nonetheless suffices to convey many of the basic ideas of these papers. To provide a point of comparison for our later discussion of foreclosure effects, we also consider here the effects of vertical mergers in the absence of competition on either the input or output markets.

Throughout sections 2, 3, and 4 we shall consider the simplest possible situation with two downstream firms, D_1 and D_2, and only one upstream firm U. (In section 5 we extend this basic setting by introducing a second upstream firm). Each firm is composed of an asset (factory, plant, equipment etc...) and a manager-owner in the situation of non-integration. Under integration, a firm will be composed of more than one asset, but each asset still requires a manager. The downstream firms each have one customer with random valuation for the final food of v_i. We shall only consider the simplified situation here where

$$(1) \qquad v_i = \begin{cases} \bar{v} \text{ with probability } \alpha \\ \underline{v} \text{ with probability } (1-\alpha) \end{cases} \qquad (i = 1, 2),$$

where $\bar{v} > \underline{v} > 0$.

v_1 and v_2 are independently distributed. We also assume that v_i may not be perfectly known to firm i at the time it must purchase its inputs. Specifically, we assume that α can take two values $\alpha_H > \alpha_L$;

$$(2) \qquad \alpha_i = \begin{cases} \alpha_H \text{ with probability } p \\ \alpha_L \text{ with probability } (1-p) \end{cases} \qquad (i = 1, 2).$$

α_1 and α_2 are independently distributed. The uncertainty about α_i is resolved before the uncertainty about v_i, and inputs are traded after the realization of α_i but before the realization of v_i.[2]

When there is no downstream competition between the two downstream firms, each can perfectly extract the surplus v_i from its customer. In order to produce the final good each D_i must use inputs supplied by U. We suppose that each D_i only produces one unit of output and requires one unit of input for the production of that unit of output. The valuations $\{v_i\}$ should be understood to be net of all of D_i's production costs other than the cost of U's input. Prior to the production stage, managers engage in value-enhancing or cost-reducing investments.

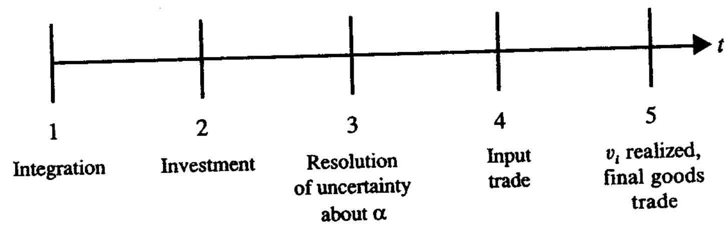
- In *BW* it is assumed that each manager of a downstream firm can perform ex ante investments to raise v_i. Here we suppose that this is achieved entirely by raising the probability p. The private cost of this investment to the manager is given by $g(p)$, where $g(\cdot)$ is a strictly increasing convex function. The upstream manager on the other hand does not engage in any ex ante investment activity.
- In *HT*, the following assumptions about ex ante investments are made: the upstream and downstream managers can invest in activities to lower respectively the upstream and downstream fixed costs of production.[3]

[2] One might think of the need to trade inputs prior to the realization of v_i as arising from a need for rapid delivery on the part of the buyers. Its main role in the model is to ensure that both downstream firms may wish to buy inputs in the case where there is downstream competition. This will obviously be true in a wide variety of models.

[3] Actually, one can view *HT* as essentially assuming that there are two types of ex ante investments: investments to set up the firm and investments to lower fixed production costs where the former are chosen by a firm's owner and the latter are chosen by an asset's manager. Throughout most of this paper we shall abstract from the former types of investments (which could in principle be introduced into the *BW* model as well).

In practice managerial investments have multidimensional aspects some of which are present in *BW* and others in *HT*. The two papers should thus be viewed as complementary, each analyzing a different polar case.

Finally, prior to the investment stage firms decide on how and whether they want to be integrated (that is, assets may be purchased and sold). Thus, the basic technological timing is given by:



The contracting assumptions in *HT* and *BW* are very similar. Both papers make the strong assumption that no ex ante contracts can be written (other than simple exchanges of assets at time 1). *BW* and *HT* discuss this assumption at length and suggest ways in which it might be derived from more primitive assumptions about enforcement, contracting and measurement costs. This assumption reflects the general theme that future delivery contracts as well as employment contracts are highly incomplete in practice and that, as a consequence, ownership of assets matters. The owner of an asset is entitled to all the residual returns generated with that asset and controls all decisions about trade and production where the use of the asset is directly involved. Ownership thus provides both a protection against the misappropriation of returns and a stronger future negotiating position whenever future trade and production decisions involving the use of the asset have to be made. When the ownership of an asset changes hands, the new acquirer sees his future returns better protected, in particular his marginal contribution to his future returns is better protected. On the other hand, the seller of the asset sees his future position deteriorate: some of the returns generated by the asset to which he ought to be entitled now go to the new owner. The allocation of ownership to different individuals thus has important consequences for the incentives to engage in ex ante investment activities.

The ex ante exchange of ownership titles creates several integration possibilities. Here we shall only compare the situations of non-integration with the situation of vertical integration where one downstream firm merges with the upstream firm. For an extensive analysis of the other cases see *BW* and HT.

It remains to specify at what terms inputs are exchanged under respectively non-integration and vertical integration. *BW* and *HT* follow different approaches in specifying bargaining between the input seller and buyers. However, most of the results obtained in each of these papers are not dependent on a specific treatment of bargaining. Consequently we shall consider the following simple model of bargaining. In the bargaining process we suppose that with probability $\frac{1}{2}$ the upstream firm can make a take-it-or-leave-it offer to each downstream firm and that with probability $\frac{1}{2}$ the downstream firms make take-it-or-leave it offers (simultaneously) to the upstream firm. We assume that bargaining takes place under symmetric information so that if D_i's realization of α is α_k, then U's equilibrium offer to D_i is $v^k = \bar{v}\alpha_k + (1 - \alpha_k)\underline{v}$ (where $k = L; H$) and D_i's equilibrium offer is zero (for simplicity we set the marginal cost of U to be equal to zero). Therefore the expected payoff to D_i is given by $\frac{1}{2}v^k$ and U's expected payoff is $\frac{1}{2}(v^{k_1} + v^{k_2})$. This bargaining solution is of course only valid in a situation where the upstream firm can produce enough inputs to cover the needs of both D_1 and D_2 and where the spot-contracts between U and D_i are not exclusive dealing contracts. Any situation where there is a real or artificially created scarcity of supplies puts the two downstream firms in competition on the input market. We analyze these situations in the next sections. Here we shall only consider which of vertical integration (*VI*) or non-integration (*NI*) is more efficient (from a social and private perspective) when the downstream firms are in competition neither on the market for inputs nor on the market for outputs.

Throughout most of the paper we can without any loss of generality restrict attention to the special case where $\alpha_L = 0$ and $\alpha_H = 1$. In this special case all uncertainty about v_i is resolved before trade of inputs takes place, so that $v^L = \underline{v}$ and $v^H = \bar{v}$. Where we do so, all the expressions derived for this special case immediately extend to the more general case by replacing $\underline{v}$ with v^L and $\bar{v}$ with v^H. Sections 2, 3.2 and 4 thus consider the special case where $\alpha_L = 0$ and $\alpha_H = 1$. Section 3.1, on the other hand, considers the general case, where $\alpha_L > 0$ and $\alpha_H < 1$.

We begin the analysis of this section using the investment assumptions considered by *HT*. Recall that they only consider ex ante fixed-cost-reducing investments by the upstream and downstream managers. Under non-integration, each firm is run by an owner-manager, so that all managers have an incentive to lower their fixed costs of production. For the sake of exposition, we imagine that the efficient level of fixed costs is zero but that managers have the ability to inefficiently extract private benefits of ξ while raising the fixed costs of the firm by $\Delta > \xi$. We denote the efficiency loss arising from this behavior by $E = \Delta - \xi$. The assumption that the level of fixed costs under non-integration is zero is inessential but allows us to ignore the possibility that one of the firms will wish to shut down.

Then, the net expected profits of each firm (Π_U; Π_{D_1}; Π_{D_2}) and the aggregate social surplus (S_{NI}) are given by:

$$\Pi_U = (1-p)\underline{v} + p\bar{v}, \tag{3}$$

$$\Pi_{D_i} = \tfrac{1}{2}[(1-p)\underline{v} + p\bar{v}], \tag{4}$$

$$S_{NI} = 2(1-p)^2\underline{v} + 2p(1-p)(\underline{v} + \bar{v}) + 2p^2\bar{v}. \tag{5}$$

Under vertical integration, (say U and D_1 merge) one of the managers in the integrated structure will not be an owner. That manager is only paid according to a fixed wage and consequently will inefficiently extract private benefits. As a result the vertically integrated structure ends up paying a fixed cost differential of $E > 0$ relative to the situation of non-integration (note that the manager's equilibrium wage will reflect his ability to extract private benefits). The profits of the integrated firm $\{U; D_1\}$ and of D_2 respectively as well as the aggregate social surplus are then given by:

(6) $$\Pi_{VI} = (1-p)\underline{v} + p\bar{v} + \tfrac{1}{2}[(1-p)\underline{v} + p\bar{v}] - E,$$

(7) $$\Pi_{D_2} = \tfrac{1}{2}[(1-p)\underline{v} + p\bar{v}],$$

(8) $$S_{VI} = 2(1-p)^2\underline{v} + 2p(1-p)(\underline{v} + \bar{v}) + 2p^2\bar{v} - E.$$

Clearly here it is not in the interest of any two firms U and D_i to merge since the costs of integration E are positive and the benefits of integration are zero. Note that it is also not socially efficient to have a vertical merger so that the bilateral incentives for a vertical merger here coincide with the social incentives.

With the investment assumptions made by *BW* exactly the opposite prediction holds. Since only downstream value-enhancing investments are important it is efficient to have a vertical merger between one downstream firm and the upstream firm, with the downstream manager becoming the owner of the vertical structure. To see this consider first the outcome under non-integration. The payoffs gross of investment costs for each downstream firm are then given by (4) so that the downstream owner-manager now chooses his level of ex ante value-enhancing investment to solve

(9) $$\max_p \tfrac{1}{2}[\underline{v} + p(\bar{v} - \underline{v})] - g(p).$$

The probability p_{NI}, emerging under non-integration is then given by the solution to:

(10) $$\tfrac{1}{2}(\bar{v} - \underline{v}) = g'(p_{NI}).$$

The first-best solution p^* is given by the equation:

(11) $$\Delta v = (\bar{v} - \underline{v}) = g'(p^*).$$

Since $g(\cdot)$ is strictly increasing and convex, one obtains that under non-integration downstream firms underinvest in p relative to the first-best.

Consider now the choice of p by the owner of the vertical structure $\{U; D_i\}$. His choice of p is given by the solution to:

(12) $$\max_{p_i} \{(\underline{v} + p_i(\bar{v} - \underline{v})) + \tfrac{1}{2}[(1-p_j)\underline{v} + p_j\bar{v}]\} - g(p_i).$$

The first-order conditions of this program then define the solution p_{VI} as:

$$\Delta v = g'(p_{VI})\,. \tag{13}$$

In other words, the owner-manager of the vertical structure chooses the first-best level of investment. The owner-manager of the remaining unintegrated firm, D_j, has the same incentives to choose p_{NI} whether D_i is integrated with U or not. Moreover, the costs of integration here are zero since the manager of the upstream firm need not be given any incentives to perform any ex ante investments. Consequently, in equilibrium, the private and social benefits from a vertical merger between U and D_i are strictly positive and are given by:

$$\Delta v\,(p_{VI} - p_{NI}) - (g\,(p_{VI}) - g\,(p_{NI}))\,. \tag{14}$$

BW thus obtain the conclusion that the bilateral net benefits of vertical integration are positive; moreover the vertical merger between U and D_i has no impact at all on the equilibrium payoffs of D_j, so that the social net benefits of a vertical merger are also positive. Social incentives again coincide with bilateral incentives but because of the different weights put on the different forms of ex ante investments *BW* reach the conclusion that vertical integration is efficient in the absence of any competition while *HT* have the opposite prediction that non-integration is efficient in these circumstances. These results are straightforward and follow from the basic ideas developed in the literature on vertical integration in bilateral settings (e.g. Grossman and Hart [1986]).

Less obvious is the fact that in the presence of competition there will be *an excessive tendency towards integration in both models* giving rise to an excessive amount of integration irrespective of whether there are efficiency gains from integration. In *HT* the introduction of competition on the output market creates an incentive for two firms, U and D_i, to merge even though non-integration remains socially efficient. In *BW*, competition between the downstream firms creates a situation where non-integration becomes socially efficient but where the bilateral incentives of firms may be to perform a vertical merger.

3. *Vertical Mergers When the Downstream Firms Compete With Each Other*

In this section we consider in turn the effects of vertical mergers when we introduce downstream competition between the D's and when we introduce competition between the D's for scarce inputs.

3.1. *Downstream Competition on the Output Market*

We shall suppose here that there is an unlimited supply of inputs that can be produced by U (that is, there is no capacity constraint) and that the downstream firms do not write any exclusive dealing contracts with U. Therefore the two downstream firms are not in competition with each other to obtain a scarce supply of inputs. They are, however, competing for customers. We shall suppose that they compete in setting prices for the final goods and that final goods are substitutes. The timing of moves is as follows: after ex ante investment levels have been chosen and the uncertainty about α has been resolved, the upstream firm trades inputs with the downstream firms. We assume in this section that $\alpha_L > 0$ and $\alpha_H < 1$, so that trade takes place before all the uncertainty about the value of v_i is resolved. To keep things as simple as possible we posit an extreme form of downstream competition by assuming that there is only one customer who receives independent draws of his valuations for D_1's and D_2's products according to the probabilities α_1 and α_2. Downstream competition takes the form of a simple Bertrand pricing game with (potentially) differentiated values. We follow *HT* in assuming that offers and transactions between U and any given downstream firm are non-observable to third parties.[4] What do these assumptions imply for the equilibrium input supply contracts? Ideally, the upstream firm would like to monopolize the downstream market, but once it has sold the monopoly quantity of inputs to one of the downstream firms it has every incentive to continue selling inputs to any downstream firm willing to buy. Such sales of inputs only hurt the downstream firms but increase the profits of the upstream firm and since input-supply contracts are non-observable the upstream firm cannot commit to no sales to the other downstream firm. Thus, monopolization through voluntary restraint in the sale of inputs is not a credible commitment.

More formally, consider the final stage outcomes of this game when each downstream firm has acquired one input. At the time when the two firms compete for customers their costs of production are sunk so that they are willing to bid their prices down to zero in order to get the customer. Consequently downstream firm D_i gets zero revenues in equilibrium whenever $v_i \leqq v_j$ and it obtains $\Delta v = (v_1 - v_2)$ when $v_i > v_j$. D_i's expected revenue from purchasing one input, given that D_j has also one input, is thus given by $\alpha_i(1 - \alpha_j)\Delta v$.

It is easy to see that the unique (pure strategy) *Perfect Bayesian Equilibrium* must involve U selling one unit to each downstream firm. When it is U's turn to make an offer, its equilibrium price offer is given by $q_i = \alpha_i(1 - \alpha_j)\Delta v$. When

[4] When a contract between two parties serves the purpose of influencing the actions of a third party, then the possibility of secret renegotiation of that contract before the third party is supposed to act can completely annihilate the commitment value of the initial contract. So much so, that the final contract between the two parties can be viewed analytically as if it was an unobservable contract. The exact conditions under which secret renegotiation completely eliminates the commitment value of the contract is the subject of active current research (see Katz [1987], Dewatripont [1988], and Caillaud, Jullien and Picard [1990]).

it is the downstream firms' turn to make an offer, they each offer a price of zero, so that equilibrium expected returns are given by the expressions in (15), (16), (17) below. To see that this is the unique equilibrium, note first that in any purported equilibrium in which U was not selling a unit to one of the downstream firms it could do better by making an offer for the sale of one unit to that firm at a price slightly less than $\alpha_i(1-\alpha_j)\Delta v$ (when it is U's turn to make an offer) and by accepting an offer slightly above zero (when it is the D's turn to make an offer). Given this fact, U must be selling a unit to each of the D's in equilibrium. If so, the most U can extract from each D_j is $q_j = \alpha_j(1-\alpha_i)\Delta v$. Thus, we have:

$$
\begin{aligned}
(15)\quad \Pi_{D_i} &= \tfrac{1}{2}\Delta v\{p(1-p)[\alpha_H(1-\alpha_L)+\alpha_L(1-\alpha_H)]+p^2\alpha_H(1-\alpha_H) \\
&\quad + (1-p)^2\alpha_L(1-\alpha_L)\}, \\
(16)\quad \Pi_U &= \Delta v\{p(1-p)[\alpha_H(1-\alpha_L)+\alpha_L(1-\alpha_H)]+p^2\alpha_H(1-\alpha_H) \\
&\quad + (1-p)^2\alpha_L(1-\alpha_L)\}, \\
(17)\quad S_{NI} &= \underline{v} + \lambda(2-\lambda)\Delta v,
\end{aligned}
$$

where $\lambda \equiv p\alpha_H + (1-p)\alpha_L$ is the ex ante probability that the customer has a high valuation for D_i's product ($i = 1, 2$).

Note that the non-integration outcome here achieves the first-best, which simply requires that the customer always buy from the downstream firm for which he has the highest valuation (first-best efficiency also requires that fixed production costs be minimized). It is obvious from these expressions, however, that downstream competition under a situation of non-integration involves the dissipation of large rents for the producers![5] The problem for the producers arises from the fact that the gains from trade between U and D_j come at the expense of D_i.

Vertical integration by U and D_i, say, will considerably reduce the extent of this rent dissipation as we demonstrate below. One of the central points in *HT* is that a *vertical merger between U and D_i creates a situation where the upstream supplier now cares about the effects of his sales to D_j on D_i's profits.* If one considers the decision to sell by the integrated structure $\{U; D_i\}$, conditional on any given realization of the α's, the integrated structure will refuse to sell to D_j if and only if

$$(18)\qquad \alpha_i\bar{v} + (1-\alpha_i)\underline{v} > [\alpha_i(1-\alpha_j) + \alpha_j(1-\alpha_i)]\Delta v,$$

[5] It may seem that the analysis above crucially hinges on our assumption that upstream production costs are equal to zero. If U had positive costs would it still wish to sell two units of inputs, when only one unit is required to serve the downstream customer? One can easily verify that indeed U would continue to sell two units in equilibrium as long as its unit production costs ar less than $\min_i \{\alpha_i(1-\alpha_j)\Delta v\}$.

or

(19) $$\underline{v} > \alpha_j (1 - 2\alpha_i)\Delta v.$$

From this we can immediately infer that if the above condition is not met, the order of desirability of sales by state of nature to the non-integrated firm is $(\alpha_L; \alpha_H) > [(\alpha_L; \alpha_L)$ or $(\alpha_H; \alpha_H)] > (\alpha_H; \alpha_L)$, where $(\alpha_i; \alpha_j)$ represents a realization of the α's. Thus, there are several possible partial or total foreclosure outcomes.

When foreclosure does not occur in state $(\alpha_i; \alpha_j)$ the expected payoffs of respectively D_j and the vertically integrated firm are obtained as follows:

When it is D_j's turn to make an offer to the vertically integrated firm it must offer at least a price equal to the payoff of the integrated firm if the latter were to refuse the sale; thus D_j must offer $(\underline{v} + \alpha_i \Delta v)$. When it is the integrated firm's turn to make an offer it can extract the full expected return of D_j so that the expected return to the integrated firm of selling to D_j is given by: $\frac{1}{2}(\underline{v} + \alpha_i \Delta v) + \frac{1}{2}\alpha_j(1 - \alpha_i)\Delta v$.

D_j's net expected payoff then is given by $\Pi_{D_j} = \frac{1}{2}[\alpha_j(1 - \alpha_i)\Delta v - \underline{v} - \alpha_i \Delta v]$ and the integrated firm's total expected payoff is

$$\Pi_{VI} = \alpha_i(1 - \alpha_j)\Delta v + \tfrac{1}{2}(\underline{v} + \alpha_i \Delta v) + \tfrac{1}{2}(\alpha_j(1 - \alpha_i)\Delta v).$$

Social surplus in this case falls (relative to non-integration) by E and consumers' surplus is unaffected by the integration decision. Note that vertical integration here has the effect of changing U's opportunity cost of selling the input to D_j. So much so, that even if vertical integration never gives rise to foreclosure in equilibrium it is still profitable for U and D_i to merge. The vertical merger raises their joint monetary payoff by forcing D_j to accept higher prices for its inputs. This increase in payoffs may outweigh the production efficiency loss of E.

When foreclosure occurs in state $(\alpha_i; \alpha_j)$, the integrated firm's expected profits in that state rise relative to the non-integration situation by $[\underline{v} - \frac{1}{2}\alpha_j(1 - 3\alpha_i)\Delta v]$, D_j's expected payoff falls by $\frac{1}{2}\alpha_j(1 - \alpha_i)\Delta v$, consumer surplus falls by $[\alpha_i \alpha_j \bar{v} + (1 - \alpha_i \alpha_j)\underline{v}]$, and aggregate surplus falls by $\alpha_j(1 - \alpha_i)\Delta v$.

Thus, the bilateral incentives here are towards a vertical merger, provided that E is not too large. But it is socially efficient for the firms to remain unintegrated. Thus, downstream competition on the final output market introduces a wedge between bilateral firm incentives and social incentives. Several remarks are in order: first, a vertical merger here is efficient even from the point of view of all firms involved when there is foreclosure as a result of integration. Total producer surplus increases in this case at the expense of consumers. Second, a vertical merger partly achieves the same outcome as a horizontal downstream merger in that it eliminates almost completely downstream competition. Yet, a horizontal merger would actually create no inefficiency here (other than the production inefficiency resulting from the merger) since, unlike under vertical integration, the consumer continues to buy from the firm he values most in all states.

To summarize, in *HT* vertical mergers are inefficient socially and undesirable for firms if there is no downstream competition. But in the presence of downstream competition there are strong private incentives for vertical mergers stemming from the possibility of foreclosure which can outweigh the losses from the increased production inefficiency in vertically integrated firms.

As in *OSS*, the fundamental driving force behind this result is the change in the incentives of U's owner after integration. The owner of U and D_i cares about the dissipation of rents of its downstream unit, after integration, and therefore refuses to sell to the non-integrated downstream firm whenever the revenues from this sale of inputs are less than the loss in profits of its downstream unit (resulting from the increased competition by the non-integrated firm). When there is more than one upstream firm, say there are two U's, then the integrated upstream firm is constrained in its attempt at foreclosing the non-integrated downstream firm by the other upstream firm's ability to supply inputs. Indeed, if the other upstream firm produces an identical product to U's at identical cost, then – absent the kind of commitment assumptions made by *OSS* – the integrated firm loses all ability to foreclose D_j. However, (as in *HT*), the integrated upstream firm continues to have some market power if it is more efficient than the other upstream firm and, as long as this is so, foreclosure may still arise.[6] Besides differences in productive efficiency one can imagine a number of alterations in other assumptions of the *OSS* model that might accomplish the same effect (e.g. differentiated products upstream rather than differential efficiency). Any situation where the incentives of an upstream firm to supply inputs to various downstream firms are changed after this firm has vertically integrated and where this upstream firm has market power may give rise to foreclosure effects.

Finally, it is also worth noting that in the *HT* model the productive efficiency effects arising from vertical mergers enter in an additive way that does not affect fundamentally the competitive interaction between the downstream firms. This is no longer the case when one considers instead the investment assumptions made by *BW*. With these assumptions the foreclosure effects of the vertical

[6] Suppose that the upstream firm faces the potential competition of an outside less efficient source. This firm has unit production costs $c > 0$. As long as $c > \max_{(i,j)} \{\alpha_i(1-\alpha_j)\Delta v\}$, the competitive threat of this outside source is irrelevant. But when this condition does not hold, then the incumbent upstream firm can no longer make a take-it-or-leave-it offer of $q_j = \alpha_j(1-\alpha_i)\Delta v$ for all $(\alpha_j; \alpha_i)$. Instead, regardless of whether it is integrated, it must set $q_j = c$ and sell to D_j whenever $c < \alpha_j(1-\alpha_i)\Delta v$ and must accept an offer of zero from D_j. (Suppose that with probability $\frac{1}{2}$ both U's make a take-it-or-leave-it offer and with probability $\frac{1}{2}$ both D's make a take-it-or-leave-it offer). The lower the unit cost of the outside source, the lower are incentives for the vertical merger. Indeed, when $c < \min_{(i,j)} \{\alpha_i(1-\alpha_j)\Delta v\}$, the incentives disappear completely.

merger are as above, but – as was true absent downstream competition – the effects of the merger on investment efficiency may now be positive, both privately and socially. For example, in the case where vertical integration leads to total foreclosure the vertically integrated firm chooses the first-best investment level (given foreclosure); this outcome dominates non-integration both privately and socially for some investment cost functions $g(p_i)$.

Finally, with both the *HT* and *BW* investment assumptions, any benefits from the vertical merger necessarily accrue to the merging parties (consumers are either unaffected by the merger or – as the unintegrated downstream firm – end up worse off), so that the merging parties generally have an excessive incentive to merge from a social point of view.

3.2. Downstream Competition on the Input Market

The downstream firms compete, de facto, on the input market whenever there is an aggregate scarcity of inputs. We shall thus suppose that the upstream firm is unable to produce enough inputs to meet the total input needs of the two downstream firms. On the other hand we now assume that the downstream firms are not competing for customers. We shall follow *BW* in assuming that each downstream firm has one captive customer and that by investing an amount $g(p_i)$ the manager of each downstream firm can raise the probability, p_i, of increasing the value of the final good to the captive customer by $\Delta v = (\bar{v} - \underline{v})$. In this section we can again restrict attention to the special case where $\alpha_L = 0$ and $\alpha_H = 1$, without any loss of generality.

When there is a scarcity of inputs, the simple bargaining situation described in the previous section no longer applies. Now we have in effect a situation of multilateral bargaining; the sale of inputs by U to D_i can no longer be considered independently from the sale of inputs to D_j, for any unit sold to D_i leaves that much less available to D_j. The upstream firm must now compare the marginal valuations of D_1 and D_2 for the input in order to determine to whom to sell the unit and at what price.

Thus, when it is the upstream firm's turn to make a take-it-or-leave-it offer it sells the single unit of input to the downstream firm with the highest v_i at a price equal to v_i. When it is the D_i's turn to make an offer they each bid for the input, so that the firm with the highest value gets the input at a price equal to the other firm's value. Therefore each D_i's expected return is $\frac{1}{2}(v_i - v_j)$ if $v_i > v_j$ and the upstream firm's expected return is:

$$\tfrac{1}{2}\max\{v_1; v_2\} + \tfrac{1}{2}\min\{v_1; v_2\}.$$

Note that the allocation of output conditional on the realization of the D's values is always efficient here. Given this bargaining solution, and using the investment assumptions of *BW*, the objective functions of respectively D_i and

U under non-integration are given by:

$$\Pi_{D_i} = \tfrac{1}{2} p_i (1 - p_j) \Delta v - g(p_i), \tag{20}$$

$$\Pi_U = \underline{v} + \tfrac{1}{2}[(1 - p_1) p_2 + (1 - p_2) p_1] \Delta v + p_1 p_2 \Delta v. \tag{21}$$

And under vertical integration, the integrated structure (say $\{U; D_1\}$) gets:

$$\Pi_{VI} = p_1 \bar{v} + (1 - p_1)(\underline{v} + \tfrac{1}{2} p_2 \Delta v) \tag{22}$$

and the non-integrated firm gets

$$\Pi_{D_2} = \tfrac{1}{2} p_2 (1 - p_1) \Delta v - g(p_2). \tag{23}$$

Now the total social expected surplus is given by

$$S = (1 - p_1)(1 - p_2)\underline{v} + (1 - p_1 - p_2 + 2 p_1 p_2)\bar{v} - g(p_1) - g(p_2). \tag{24}$$

Note that, as in GROSSMAN and HART [1986] the only distortion in welfare that arises here is due to distortion in ex ante investments. The first-best solution in ex ante investment levels is obtained from the following first-order conditions:

$$(1 - p_j^*) \Delta v = g'(p_i^*). \tag{25}$$

Under vertical integration, the integrated firm's investment level is given by

$$\Delta v (1 - \tfrac{1}{2} p_2) = g'(p_{VI}), \tag{26}$$ (26)

while the non-integrated firm's investment decision is the solution to

$$\tfrac{1}{2}(1 - p_{VI}) \Delta v = g'(p_2). \tag{27}$$ (27)

Comparing the best-response functions given in (25), (26) and (27), one immediately observes that under vertical integration the vertical structure over-invests relative to the first-best. This in turn implies that D_2, the non-integrated firm, underinvests relative to the first-best.

Now, under non-integration each firm's ex ante investment level is given by the solution to the system of first-order conditions

$$\tfrac{1}{2}(1 - p_j^{NI}) \Delta v = g'(p_i^{NI}). \tag{28}$$

Comparing (25) with (28) one observes that under non-integration each downstream firm underinvests. Thus, neither vertical structure implements the first-best so that it is not immediately obvious which one dominates the other. Depending on the parameter values non-integration may dominate vertical integration or vice versa. This is in contrast to the situation with no competition for inputs, where vertical integration unambiguously dominates non-integration (with the *BW* investment assumptions).

The positive effect of competition for inputs on investment incentives, under non-integration, is even more striking when one considers the bargaining game in *BW*. They let the D_i and U play an alternating-offers Rubinstein bargaining game with three players under non-integration; and a two player Rubinstein bargaining game with an outside option under vertical integration. (In other words, when the vertically integrated firm is bargaining with D_j it always has the option of supplying the input internally). The equilibrium outcome in each bargaining game is then given by a sale of the input to D_j whenever $v_j > v_i$ at a price.[7]

$$P = \begin{cases} v_i & \text{if } v_i > \dfrac{v_j}{2} \\ \dfrac{v_j}{2} & \text{if } v_i < \dfrac{v_j}{2} \end{cases}$$

When $\underline{v} > \bar{v}/2$ we thus have $P = \underline{v}$ so that both D_i's expected payoff under non-integration is given by:

$$\Pi_{D_i} = p_i(1 - p_j)\Delta v - g(p_i) \tag{29}$$

and the expected payoff functions under integration are given by

$$\Pi_{VI} = p_i\bar{v} + (1 - p_i)\underline{v} - g(p_i), \tag{30}$$

$$\Pi_{D_j} = p_j(1 - p_i)\Delta v - g(p_j). \tag{31}$$

It follows that under non-integration each downstream firm chooses the first-best investment level; with the *BW* bargaining assumptions competition for inputs thus creates an efficient incentive scheme for downstream firms (under non-integration) in a wide range of cases. On the other hand, vertical integration continues to give rise to overinvestment by the vertically integrated

[7] The basic idea here is that if v_j is equal to zero then this multilateral bargaining problem essentially reduces to a bilateral bargaining problem where the solution is given by $P = v_i/2$. This remais true when v_j is positive but small. However, if v_j is larger than $v_i/2$, the upstream firm's threat of selling to firm D_j at a price $P = v_j$ if firm D_i does not accept a price equal or higher than v_j becomes credible. (It is credible, roughly, because in equilibrium D_j never gets the input and thus obtains a payoff of zero; it is therefore willing to accept an out-of-equilibrium offer of v_j which also gives a zero payoff). Consequently D_j has no choice but to accept a price of v_i.

structure and underinvestment by D_j. Even though on average downstream firms are worse off when they have to compete for inputs, at the margin their rents are better protected.[8] To summarize, when firms are in competition on the input market, non-integration may become a more efficient vertical structure of production than vertical integration. However, even if it is efficient from the viewpoint of society as well as all three producers to implement the non-integration outcome, it is not in the interest of any coalition of two producers (one upstream, the other downstream) to remain unintegrated. This is best seen when one considers the BW bargaining solution. By remaining unintegrated U and D_i then obtain aggregate payoffs of:

$$p_i^{NI}\bar{v} + (1 - p_i^{NI})\underline{v} - g(p_i^{NI}), \tag{32}$$

while if they integrate, they get

$$p_{VI}\bar{v} + (1 - p_{VI})\underline{v} - g(p_{VI}). \tag{33}$$

Since p_{VI} is the solution to the first-order conditions of (33) and p_i^{NI} is not, it immediately follows that U and D_i gain by integrating. This gain arises from the fact that integration induces indirect foreclosure by forcing D_j to underinvest and $\{U; D_i\}$ to overinvest.

Note that investment effects are central to the foreclosure outcomes described here. If one were to use instead the investment assumptions of HT here, there would be no foreclosure effect at all. Again, the reason is that with the HT investment assumptions the productive efficiency effect of vertical integration enters in an additive way which does not influence competition for inputs.

4. *Several Upstream Firms and Chains of Integration*

All of the preceding analysis can be and has been extended to situations with several upstream firms. Both BW and HT have considered a game with two downstream firms, D_1 and D_2, and two upstream firms, U_1 and U_2. The new complication arising in this situation concerns the incentives of, say, D_2 and U_2 to integrate following the integration decision of U_1 and D_1. In other words, the interesting new problem arising here is whether there exist chains of integration phenomena, where the integration decision of two firms, U_i and D_i, triggers the vertical integration of the remaining firms, U_j and D_j.

[8] D_i's ex ante investment is only socially valuable in the event where $v_i = \bar{v}$ and $v_j = \underline{v}$. Thus the manager of D_i has the correct social incentives to invest if his objective function is given by $p_i(1 - p_j)\Delta v - g(p_i)$. In other words, D_i has the correct incentives if he appropriates fully the social expected marginal returns from his investment. Now competition between the two downstream firms only provides each D_i with those returns.

Both *HT* and *BW* show that, indeed, chains of integration can arise in equilibrium. That is to say, U_2 and D_2 want to merge only as a result of the merger of U_1 and D_1. And U_1 and D_1 prefer to merge even if their integration triggers a merger by U_2 and D_2. Another possibility is that U_1 and D_1 refrain from integrating even if there are positive private gains from integration if D_2 and U_2 remain unintegrated, since the merger of U_1 and D_1 triggers a merger by U_2 and D_2 which eliminates the integration gains of U_1 and D_1.

As in section 3, we shall investigate the incentives for vertical integration restricting attention in turn to the case where downstream firms compete only on the final goods market (no capacity constraints upstream) and where they compete only on the input market. A detailed treatment of all the possible outcomes in this enlarged framework with two upstream firms would be rather lengthy. Consequently, we shall limit ourselves here to an analysis of the main effects and we refer the interested readers to the *BW* and *HT* papers for a complete description of all the strategic aspects of this situation.

4.1. Competition in the Final Goods Market

HT introduce two active upstream firms by assuming that it is not known in advance which of the two will be more efficient than the other. In our simple model, the most straightforward way of introducing two active upstream firms is to assume that the unit costs of each upstream firm, c_i, are either equal to zero or to ∞ and that with probability $\lambda \in (0, 1)$ we have $c_1 = 0$ and $c_2 = \infty$ while with probability $(1 - \lambda)$ the reverse is true. These production costs become known at the same time as the downstream α's.

HT consider a "reduced form" merger game in which each D_i is assumed to only be able to merge with U_i for $i = 1, 2$. The timing of the game is as follows: first, each U/D pair simultaneously decides whether to merge, and then, if (and only if) U_i/D_i have merged, the U_j/D_j pair may respond by merging. *HT* discuss a richer continuous time merger game which yields the same prediction as the (unique) equilibria of this reduced form game.

It is easy to see from our earlier analysis that in this simple model the loss imposed on the U_j/D_j pair by a U_i/D_i merger, which we shall for convenience denote by L_j, is independent of whether U_j and D_j are themselves merged (the loss arises only when U_i is the upstream firm with $c_i = 0$). The same is true of U_i/D_i's joint gain from this merger (excluding the efficiency loss E), which we denote by G_i.[9] Thus, each pair U_i/D_i responds to the merger of the other pair by merging if and only if $G_i > E$.

To see how chains of integration might arise, suppose that $G_1 - L_1 > E$ and that $E \in (G_2 - L_2, G_2)$. This might happen when λ is larger than 1/2 but not too much (since as λ approaches 1, G_2 approaches zero). In this case, U_2/D_2 will

[9] As suggested by the discussion in footnote 6 above, the same basic results hold when the inefficient firm's cost is any $c > 0$ (and, indeed, for general distributions of costs).

not merge unilaterally because they are worse off merging given that U_1/D_1 will respond by merging.[10] In contrast, U_1/D_1 is willing to merge despite the fact that U_2/D_2 will respond by merging; thus U_1/D_1 will start a chain of integration. It is easy to see that we may also get situations in which no mergers occur because of the fear of starting a chain of integration. Just let $E \in (G_1 - L_1, G_1)$ also. Finally, note that our earlier analysis implies that a no integration outcome is always the socially efficient outcome here.

4.2. *Downstream Competition on the Input Market*

In contrast to *HT*, *BW* introduce a second upstream firm into their model which is identical to the first (i.e., one with production costs of zero and a capacity constraint of one unit). They also assume that investments are supplier-specific: each downstream firm must decide which U to invest toward and has no use ex post for an input supplied by a U toward which it has not invested. In additon, *BW* analyze the merger process somewhat differently than do *HT*. Nevertheless, for simplicity and the sake of comparison, we shall continue to use the *HT* reduced form merger game here (the points below would remain unchanged if we instead used *BW*'s approach).

In the absence of any integration, each D invests toward a different one of the U's (label the U that D_i invests toward by U_i) and, as in Section 2, each D underinvests. It is clear in this setting that the joint payoff of U_i/D_i is independent of whether U_j/D_j merge and that their joint payoff is larger (typically strictly) when they are merged since the investment of D_i is set to maximize their joint payoff. Hence, in the *BW* model, we always see both pairs unilaterally vertically integrating. Note that this outcome yields the first-best here: with two upstream firms there is no supply assurance problem and so social welfare is maximized as long as each D owns a U.

Of greater interest in the *BW* setting is a second kind of "chain of integration". In particular, we may also consider a situation in which initially only one U exists, but in which downstream firms can backward integrate by building their own upstream production unit for some cost K. For simplicity, imagine that in the reduced form merger game U_1/D_1 can merge as before but that now D_2 can build its own upstream unit. Given the discussion above, if D_2 unilaterally builds an upstream unit its payoff is given by $\Pi_2^{VI} - K$ where $\Pi_2^{VI} = \max [\underline{v} + p_2 \Delta v - g_2(p_2)]$ regardless of whether U_1/D_1 integrates in response. This is also its payoff if it integrates in response to a merger by U_1/D_1. Now, suppose that $\Pi_2^{VI} - K$ is less than D_2's payoff when only one upstream asset (U_1) exists and it is independent. Then only if U_1/D_1 merge first will D_2 backward integrate. In fact, though, because D_2's payoff when U_1/D_1 have

[10] More precisely, "no merger" is their weakly dominant strategy in stage one of the reduced form merger game.

merged is strictly less than its payoff when U_1 is independent, it is easy to construct cases in which D_2 would backward integrate in response to such a merger. Furthermore, if the investment efficiency gains to a U_1/D_1 merger are large or if the surplus they jointly extract from selling to D_2 is small, U_1/D_1 may merge anyway, leading to a chain of integration. This chain of integration may well be socially inefficient and, in general, D_2 always has an excess incentive to respond to a U_1/D_1 merger with backward integration of its own.[11]

5. Conclusion

The foreclosure effects of vertical mergers are complex and not fully understood as yet. Without doubt, the criticisms of the "New School of Antitrust" (as presented in BORK [1978]) pointed to important flaws in the courts' historic acceptance of foreclosure theory. In response to these criticisms, however, more recent research such that in *OSS*, *HT*, and *BW* has formally demonstrated that vertical mergers resulting in market foreclosure can indeed be an equilibrium phenomenon.

Given the difficulty of the task of authorizing the vertical mergers that are genuinely efficiency-enhancing and banning those that are not, does this mean that one should have a policy of "laisser faire"?

A complete answer to this question would of course involve a detailed study investigating the costs and benefits of various antitrust regulations governing vertical mergers, including their enforcement costs. So far we only have haphazard, anecdotal evidence about existing regulations and existing antitrust cases. It is worth pointing out that similar difficulties of enforcement arise in horizontal merger cases. Nevertheless, antitrust authorities have resorted to rules of thumb (such as concentration ratios, stock price reaction, etc...) which have been useful. Perhaps similar rules of thumb may be developed for vertical mergers. To determine such rules, however, further research is required. At this point, perhaps the best ex ante guide is one already mentioned in BORK [1978], namely the degree of concentration in either the upstream or downstream market. Foreclosure effects are more likely to be present in situations in which one of these markets is highly concentrated!

---

[11] One can also consider this type of backward integration in a setting of downstream competition like that considered above. Suppose, for example, that D_2 can build a second upstream plant for cost K that may have costs of either zero or $c > 0$ as in subsection 4.1. Unlike the analysis there, D_2's gain from this type of backward integration is generally larger when U_1/D_1 are merged than when they are not integrated because the presence of the second upstream unit may prevent the harmful foreclosure that occurs with vertical integration of U_1 and D_1 (recall footnote 6).

References

BOLTON, P. and M. D. WHINSTON [1990], "Incomplete Contracts, Vertical Integration and Supply Assurance," working paper 332, École Polytechnique.

BORK, R. H. [1978], *The Antitrust Paradox*, New York: Basic Books.

Brown Shoe Co. vs. United States, 370 U.S. 294, [1962].

CAILLAUD, B., B. JULLIEN and P. PICARD [1990], "Competing Vertical Structures: Precommitment and Renegotiation," mimeo, CEPREMAP.

DEWATRIPONT, M [1988], "Commitment Through Renegotiation-Proof Contracts With Third Parties," *Review of Economic Studies*, 55, 377–390.

GROSSMAN, S. J. and O. D. HART [1986], "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94, 691–719.

HART, O. D. and J. TIROLE [1990], "Vertical Integration and Market Foreclosure," *Brookings Papers*, 205–276.

KATZ, M. [1987], "Game-Playing Agents: Contracts as Precommitments," mimeo, University of California, Berkeley.

ORDOVER, J. A., G. SALONER, and S. C. SALOP [1990], "Equilibrium Vertical Foreclosure," *American Economic Review*, 80, 127–142.

Professor Patrick Bolton
Laboratoire d'Économétrie de l'École Polytechnique
1 Rue Descartes
F-75230 Paris Cedex 05
France

Professor Michael D. Whinston
Department of Economics, Littauer Center
Havard University
Cambridge, MA 02138
U.S.A.