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On vertical mergers and their competitive effects

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It is well known that vertical integration can change the pricing incentive of an upstream producer. However, it has not been noticed that vertical integration may also change the pricing incentive of a downstream producer and the incentive of a competitor in choosing input suppliers. I develop an equilibrium theory of vertical merger that incorporates these additional strategic considerations. Under fairly general conditions, a vertical merger will result in both efficiency gains and a collusive effect. The competitive effects of a vertical merger depend on the cost of switching suppliers and the degree of downstream product differentiation.

1. Introduction

■ An important issue in economics and antitrust is how vertical mergers affect competition. The traditional market-foreclosure theory, which was accepted in leading court cases in the 1950s through the 1970s, viewed vertical mergers as harming competition by denying competitors access to either a supplier or a buyer.[1] The foreclosure theory has received strong criticism from authors commonly associated with the Chicago School. The critics argue that the theory is logically flawed, and that a vertically integrated firm cannot benefit from excluding its rivals (e.g., Bork, 1978 and Posner, 1976). The Chicago School view led to a new perspective in which vertical mergers were generally considered to be competitively neutral or procompetitive and, in the 1980s, to more favorable treatment of vertical mergers in antitrust cases (Riordan and Salop, 1995).[2]

More recently, a new school of thought has emerged that has shed new light on the issue of the competitive effects of vertical mergers. This post-Chicago approach, as it is called by Riordan and Salop, combines the economic analysis of the Chicago School with the newer methodology of modern industrial organization theory. Focusing on oligopoly market structures, this new analysis has shown how the logical difficulty in the traditional foreclosure theory can be resolved and how

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[1] See, for example, *Brown Shoe Co.* v. *United States*, 370 US 294 (1962), and *Ford Motor Co.* v. *United States*, 286 F. Supp. 407 (E.D. Mich. 1968).

[2] The procompetitive effect of vertical mergers can arise from, for instance, eliminating double markup or avoiding inefficient input substitution. See Perry (1989) for a survey of the literature.

vertical mergers can lead to anticompetitive effects in some situations. A fundamental insight of this approach is that vertically integrated firms will have incentives that differ from those of nonintegrated ones when competing in the input (upstream) market. An integrated firm will recognize that it can benefit from the higher costs imposed on its downstream rivals when it refrains from pricing aggressively in the input market. Vertical foreclosure can therefore arise in equilibrium. The article by Salop and Scheffman (1987) forms the basis for this argument, and Ordover, Saloner, and Salop (1990, hereinafter OSS) is perhaps the best-known article that pioneered the equilibrium approach to the analysis of vertical mergers.[3]

In this article, I shall argue that the new theories on vertical mergers have ignored an important point, namely that vertical integration not only changes an *upstream* firm's pricing incentive, but it may also change a *downstream* firm's pricing incentive and a *competitor's* incentive in choosing input suppliers. Once this is realized, an equilibrium theory of vertical merger can be developed without some controversial assumptions in the literature, and this theory can provide a framework in which the competitive effects of vertical mergers are measured and compared. The basic insight of my analysis is that vertical integration creates multimarket interaction between the integrated firm and its downstream rivals. A vertically integrated firm will recognize that its more aggressive prices in the downstream market can hurt its profit in the upstream market, if it supplies inputs to its downstream rivals. This in turn affects a rival's incentive in selecting its input supplier, making it a strategic instead of a passive buyer in the input market.

I consider a model in which two differentiated downstream firms use a homogeneous input produced by two or more upstream firms. In the upstream industry, one firm may be more efficient than others, in the sense that its constant marginal cost (m_1) may be lower than the others' (m). The downstream firms can first bid to acquire an upstream producer, and the remaining independent downstream firm can counter the merger by integrating with another upstream producer. The upstream producers then announce input prices, after which downstream firms determine prices and purchase inputs to produce the output demanded. A downstream firm may need to make a certain arrangement (relationship-specific investment) in order to purchase from a supplier. I incorporate this consideration by assuming that a downstream firm incurs cost $s \geq 0$ for each additional supplier it arranges to purchase input from, whether or not the arrangement is made before downstream prices are set. One may consider s as a measure of whether spot transactions in the input market are readily available.

My main result is that vertical mergers occur in equilibrium if and only if $m_1 < m$ (i.e., one of the upstream producers is more efficient than the others). When $m_1 < m$, a downstream firm will integrate with the more efficient upstream firm, and the unintegrated downstream firm will choose the integrated firm as its input supplier. The integrated firm will have a lower marginal cost in the downstream market and hence *more* incentive to lower its downstream price; but since it supplies input to the downstream rival at a price above marginal cost, it also has *less* incentive to lower its downstream price. These are what I shall call the efficiency and collusive effects of vertical mergers. It follows that a vertical merger will involve both effects. Moreover, an unintegrated downstream firm may choose the integrated firm as its supplier even when the latter's input price is somewhat higher than prices of alternative sources. To see how this happens, suppose that all upstream producers offer input price m, as if they are Bertrand competitors in the input market (which would be the outcome if no vertical integration had occurred). But the unintegrated downstream firm will prefer to choose the integrated firm as its supplier, since the latter will then have less incentive to lower prices in the downstream market. This may enable the integrated firm to raise its rival's input price above m.

The extent to which the integrated firm can raise its rival's cost depends importantly on the value of s, or whether spot transactions on the input market are readily available. If $s = 0$, the rival will purchase from the supplier with the lowest price once downstream prices are set, even though *ex ante* it may choose the integrated firm as its supplier. In this case, the equilibrium price

[3] Other important contributions include Salinger (1988) and Hart and Tirole (1990).

in the input market will be m, and the integrated firm is unable to raise its rival's cost.[4] On the other hand, if $s > 0$, the integrated firm's input price will be above m just so much that the rival is still willing to purchase. In equilibrium, s serves as a switching cost that prevents a firm from switching suppliers. Thus, vertical merger can cause market foreclosure, in the sense of raising a rival's cost and reducing the rival's output. Ironically, this happens not because the integrated firm will refrain from supplying the rival, but rather because the integrated firm will continue to supply the rival. This result may seem surprising and even counterintuitive, but it becomes easier to understand if one realizes that firms may compete less aggressively if they are also customers/suppliers to each other.[5] The market foreclosure in my model is thus a consequence of tacit collusion by the integrated firm and its downstream rival.[6] However, such market foreclosure need not raise prices in the final market, since vertical merger can occur in equilibrium only if it results in an efficiency gain. If s is equal to or sufficiently close to zero, the efficiency effect dominates the collusive effect and a vertical merger benefits consumers. But if s is significant, a vertical merger tends to harm consumers when the downstream products are close substitutes.

It is common for a vertically integrated firm to continue supplying inputs to its downstream rivals. Although no formal model in the literature has explored the collusive incentives identified here, concerns about them have been raised by government agencies in evaluating vertical mergers. In March 1998, for instance, the U.S. Department of Justice challenged Lockheed Martin's proposed acquisition of Northrop, alleging among other things that the merged firm and Boeing would be "teamed in virtually every military aircraft currently in production" and that such "increased interdependence" might lead to reduced competition (Morse, 1998, p. 1238). The proposed merger was eventually abandoned.[7] The point of this article, however, goes beyond showing that such concerns may have theoretical merit, in a rather unanticipated way; it also shows that the possible collusive effect of a vertical merger will necessarily be accompanied by an efficiency effect, and economic analysis can help determine how, on balance, consumers will be affected.

The rest of the article is organized as follows. Section 2 describers the details of the model. Section 3 solves the equilibrium of the model and establishes the main result. Section 4 studies the competitive effects of vertical mergers. Section 5 discusses alternative assumptions and the robustness of my results. Section 6 concludes.

2. The model

■ Two (downstream) firms, $D1$ and $D2$, produce differentiated products.[8] The demand functions for their products are $q_i(p_1, p_2)$, where p_i is Di's price, $i = 1, 2$. The production in the downstream industry, D, requires an input that is produced in an upstream industry, U. There are $h \geq 2$ upstream producers, $U1, U2, \ldots, Uh$, producing a homogeneous input for the downstream industry. The constant marginal cost of production for $U1$ is m_1, and that for the other upstream firms is m, where $0 \leq m_1 \leq m$. Thus $U1$ may have a cost advantage relative to other upstream firms.[9]

[4] Even in this case a vertical merger will have both the collusive and efficiency effects, although, as it turns out, the efficiency effect will dominate.

[5] Fauli-Oller and Sandonis (2000) explore this point in the context of licensing. When a firm licenses its technology to a competitor through a royalty contract, the licensor has an incentive to keep up the sales amount of the licensee, which can induce the licensor to refrain from aggressive pricing.

[6] Notice that no explicit transfer payments are needed/involved here. It is the multimarket interaction generated by the vertical merger that can support collusive behavior as an equilibrium outcome in a noncooperative game.

[7] Similar concerns have been raised in some other recent vertical merger cases. For instance, in 1995, the Federal Trade Commission challenged Eli Lilly's proposed acquisition of PCS Health Systems, alleging that "as a result of Lilly's contact through PCS with other pharmaceutical companies, collusion would be facilitated" (Morse, 1998, p. 1239). See Section 4 for more discussion on recent vertical merger cases.

[8] My results will extend to situations in which there are more than two downstream firms. Considering only two downstream firms makes the analysis tractable.

[9] If $h = 2$ and $m = m_1$, this setting would be similar to the basic model in OSS.

The analysis will not change if $U1, \ldots, Uh$ all have constant marginal cost m, but a vertical merger between a firm in D and $U1$ reduces $U1$'s marginal cost from m to m_1.[10] Thus the model can equivalently be viewed as one in which a vertical merger with a particular upstream firm may lead to a cost reduction. To keep the exposition concise, I will talk about this alternative interpretation only when necessary.

There is a fixed-coefficient technology such that each unit of output in D requires one unit of input from U. The cost of other inputs in D is normalized to zero (thus the firms in D are symmetric).

To develop an equilibrium theory of vertical mergers, I follow OSS and consider a game with the following stages. In stage 1, downstream firms can bid to acquire $U1$. When a vertical acquisition occurs, I assume, without loss of generality, that it is conducted by $D1$ and the integrated firm is called F. In stage 2, $D2$ can counter the merger of $D1$ and $U1$, if there is one, by a merger with an unintegrated U firm, say, $U2$. In stage 3, upstream producers simultaneously announce the prices at which they are willing to supply any unintegrated downstream firm.[11] A downstream firm can then choose one or more suppliers from whom it intends to purchase inputs, which involves certain arrangements that can be costly. I assume that the cost to arrange with only one supplier is zero, but arranging with each additional supplier costs a downstream firm $s \geq 0$.[12] In stage 4, downstream firms simultaneously choose prices, given input prices and the identities of suppliers, and inputs are purchased to produce the output demanded.[13] A downstream firm can also arrange with (choose) a supplier at stage 4, once downstream prices are determined. Since s can be avoided if a firm chooses and purchases from only one supplier, in equilibrium s serves as a switching cost. To avoid trivial situations, I assume that if firms are indifferent between merger or no merger, they choose no merger, as would be the case if mergers involve costs (e.g., legal costs). Figure 1 illustrates the game (the notations used therein will become clear in the text to follow).

The major differences here from OSS are as follows: (i) no additional commitment power is given to F, (ii) one of the upstream firms is allowed to have a lower cost than other upstream firms, (iii) the identity of the supplier may matter to a downstream firm, and (iv) transactions in the input market may differ from spot-market transactions.[14] I incorporate the idea that the identity of suppliers may matter to a downstream firm by assuming that it can choose its supplier at stage 3, before the downstream prices are determined. The presence of cost s in arranging with an additional supplier makes this choice nontrivial, although the firm is not required by contract to purchase from the supplier chosen at stage 3.[15]

Like OSS, I assume that the demand functions for the two products in D are symmetric, namely $q_1(a, b) = q_2(b, a)$. As a preliminary step in the analysis, I first consider the downstream market in isolation without modelling its strategic interaction with the upstream market. Suppose that $D1$ and $D2$ have marginal costs c_1 and c_2. Their profits are

$$\pi_i = (p_i - c_i)q_i(p_1, p_2), \qquad i = 1, 2.$$

[10] If we adopt this interpretation, we assume that only $U1$ has the ability to reduce its marginal cost to m_1 by merging with a firm in D.

[11] For a vertically integrated firm, I assume that the internal input transfer price will be set at the efficient level, which is the marginal cost of the upstream division.

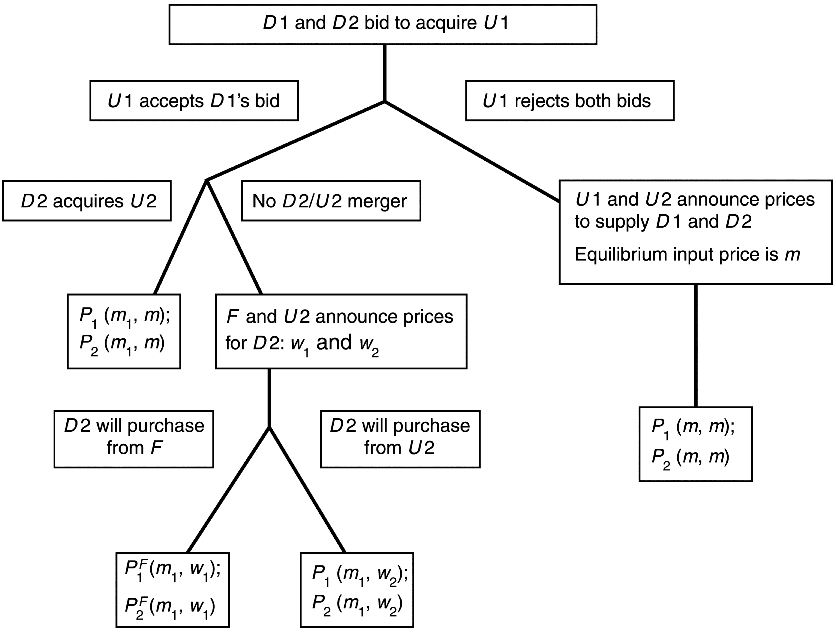
[12] If there is a cost to make arrangements even with only one supplier, it will just add a fixed cost to a downstream firm and reduce its equilibrium profit. As long as this cost is small so that downstream firms will remain active producers, normalizing it to zero does not change our analysis.

[13] My results will be the same whether the actual purchase of inputs happens at the same time that downstream prices are determined or afterward.

[14] In OSS, F can first commit to a price higher than m, which enables $U2$ to raise its price to $D2$, causing market foreclosure. Hart and Tirole (1990) and Reiffen (1992) make the criticism that this foreclosure result is driven by the integrated firm's additional commitment ability. See also the response to this criticism by Ordover, Saloner, and Salop (1992).

[15] See Section 5 for a discussion of what happens if requirement contracts are allowed.

FIGURE 1



The Nash equilibrium in prices solves the following first-order conditions:

$$(p_i - c_i)\frac{\partial q_i(p_1, p_2)}{\partial p_i} + q_i(p_1, p_2) = 0, \qquad i = 1, 2. \tag{1}$$

Assume that a unique equilibrium exists for the relevant ranges of c_i, and denote equilibrium prices and profits as

$$p_i(c_1, c_2) \text{ and } \pi_i(c_1, c_2), \qquad i = 1, 2.$$

In particular, $p_i(m, m)$ and $p_i(m_1, m)$ are given by (1). By the symmetry of the demand functions, $p_1(c_1, c_2) = p_2(c_1, c_2)$ and $\pi_1(c_1, c_2) = \pi_2(c_1, c_2)$ if $c_1 = c_2$. I assume that prices are strategic complements, as in OSS: namely, an increase in firm j's price increases the marginal profit of firm i for $i \neq j$. If we were to draw a diagram placing p_1 on the horizontal axis and p_2 on the vertical axis, the reaction curves defined by (1) would be upward slopping, with the one for $i = 1$ being steeper, assuming that the usual stability condition,

$$\left|\frac{\partial^2 \pi_i}{\partial p_i \partial p_j}\right| < \left|\frac{\partial^2 \pi_i}{\partial p_i^2}\right|,$$

is satisfied. One can show (see OSS) that

$$0 < \frac{\partial p_i(c_1, c_2)}{\partial c_1} < 1 \text{ and } 0 < \frac{\partial p_i(c_1, c_2)}{\partial c_2} < 1. \tag{2}$$

That is, an increase in the marginal cost of a downstream firm increases the prices in the downstream market.

It then follows, from the envelope theorem, that

$$\frac{\partial \pi_i(c_1, c_2)}{\partial c_j} = (p_i - c_i)\frac{\partial q_i(p_1, p_2)}{\partial p_j}\frac{\partial p_j(c_i, c_j)}{\partial c_j} > 0, \qquad i, j = 1, 2 \text{ and } i \neq j.$$

That is, a downstream firm's profit increases in its rival's cost.

I shall also assume the following:

$$0 < \frac{\partial q_i(p_1, p_2)}{\partial p_j} < -\frac{\partial q_k(p_1, p_2)}{\partial p_k}, \qquad i, j, k = 1, 2 \text{ and } i \neq j. \tag{3}$$

That is, products are substitutes and demand for a product is more responsive to its own price change than to the price change of another product.

For illustration, let us consider a linear-demand example.

Example 1. Assume $q_i = 1 - p_i + \beta(p_j - p_i)$, $i, j = 1, 2$, where $\beta \in (0, \infty)$ is a measure of product differentiation, and a higher β means less product differentiation. Then from (1), for $i, j = 1, 2$ and $i \neq j$,

$$p_i(c_1, c_2) = \frac{2 + 3\beta + 2(1+\beta)^2 c_i + \beta(1+\beta)c_j}{(2+\beta)(2+3\beta)},$$

$$\pi_i(c_1, c_2) = (1+\beta)\frac{\left(2 + 3\beta - (2 + 4\beta + \beta^2)c_i + (\beta + \beta^2)c_j\right)^2}{(2+\beta)^2(2+3\beta)^2}.$$

One can verify that both conditions (2) and (3) are satisfied.

Note that for any given demand functions, both m_1 and $m - m_1$ should be relatively small, so that positive output will be produced and effective competition exists in U. For our linear-demand example, we need $m_1 < 1$ and

$$m \leq m_1 + (1 - m_1)\frac{(1+2\beta)(2+3\beta)\left(3\beta^2 + 6\beta + 4\right)}{(1+\beta)\left(9\beta^2 + 16\beta + 8\right)\left(2 + 4\beta + \beta^2\right)}. \tag{4}$$

3. Equilibrium analysis

■ If no vertical merger occurs at stage 1, competition among the upstream firms means that $D1$ and $D2$ will purchase from $U1$ at the equilibrium input price m or from any upstream firm if $m = m_1$.[16] Thus without vertical merger the equilibrium profits for $D1$, $D2$, and $U1$ are simply $\pi_1(m, m)$, $\pi_2(m, m)$, and $(m - m_1)[q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))]$. Since there is no incentive for a downstream firm to switch suppliers once it has chosen one, s has no effect on competition.[17]

The subgame that starts from the vertical merger of $D1$ and $U1$ will be solved using backward induction. First I shall characterize equilibrium in the downstream market at stage 4 after only $D1$ and $U1$ have vertically integrated, then study equilibrium in the upstream market after that merger, and then consider whether in equilibrium $D2$ would want to counter the $D1/U1$ merger by a merger with another upstream firm.

I shall finally solve the entire model by considering when there is vertical merger in equilibrium.

□ **The downstream market with vertical merger of *D*1 and *U*1.** To characterize equilibrium in the downstream market at stage 4 when only $D1$ and $U1$ have merged, there are two possible cases to consider, depending on from whom $D2$ will purchase inputs in equilibrium, which in turn will depend on the prices of different suppliers and whether $D2$ has chosen any supplier(s) previously. Let the price of F in the input market be w_1, and let the lowest price offered by

[16] Notice that as long as $m - m_1$ is not too large, $U1$ will not want to charge a price lower than m.

[17] Again, if a downstream firm were to incur a cost, say f, when it chooses only one supplier, the equilibrium outcomes are not changed as long as $\pi_1(m, m) - f > 0$.

$U2, \ldots, Uh$ be w_2. Without loss of generality, assume that $U2$ offers w_2 and that $D2$ purchases from $U2$ if it purchases from an unintegrated firm. Then,

(i) $D2$ will purchase input from $U2$ at price w_2. In this case, F and $D2$ will act in D as if they are two stand-alone downstream firms with marginal costs $c_1 = m_1$ and $c_2 = w_2$. The downstream equilibrium prices for F and $D2$ are simply $p_1(m_1, w_2)$ and $p_2(m_1, w_2)$, and their profits are simply $\pi_1(m_1, w_2)$ and $\pi_2(m_1, w_2)$.[18] Notice that in this case $D2$ interacts with F in D but not in U.

(ii) $D2$ will purchase input from F at price w_1. In this case, $c_1 = m_1$ and $c_2 = w_1$, but now $D2$ interacts with F both in D and in U. Let the profit of F be π_1^F, and let the profit of $D2$ be π_2^F. Then

$$\pi_1^F = (p_1 - m_1)q_1(p_1, p_2) + (w_1 - m_1)q_2(p_1, p_2),$$
$$\pi_2^F = (p_2 - w_1)q_2(p_1, p_2).$$

In equilibrium, $p_1^F(m_1, w_1)$ and $p_2^F(m_1, w_1)$ solve the first-order conditions:

$$(p_1 - m_1)\frac{\partial q_1(p_1, p_2)}{\partial p_1} + q_1(p_1, p_2) + (w_1 - m_1)\frac{\partial q_2(p_1, p_2)}{\partial p_1} = 0, \quad (5)$$

$$(p_2 - w_1)\frac{\partial q_2(p_1, p_2)}{\partial p_2} + q_2(p_1, p_2) = 0. \quad (6)$$

Comparing these conditions with those for $p_1(\cdot, \cdot)$ and $p_2(\cdot, \cdot)$ in (1), the crucial difference is that there is now an extra term, $(w_1 - m_1)[\partial q_2(p_1, p_2)/\partial p_1]$, that is not present when $D2$ purchases from an unintegrated firm in U. Denote the equilibrium profits in this case by $\pi_1^F(m_1, w_1)$ and $\pi_2^F(m_1, w_1)$.

Similar to (2), we have

$$0 < \frac{\partial p_i^F(m_1, w_1)}{\partial m_1} < 1 \text{ and } 0 < \frac{\partial p_i^F(m_1, w_1)}{\partial w_1} < 1. \quad (7)$$

Comparing the conditions for $p_i^F(m_1, w_1)$ in (5) and (6) with those for $p_i(m_1, w_1)$ in (1), since $\partial q_2/\partial p_1 > 0$ and prices are strategic complements, we have the following:

Lemma 1. For $i = 1, 2$, $p_i^F(m_1, w_1) > p_i(m_1, w_1)$ if $w_1 > m_1$; and $p_i^F(m_1, w_1) = p_i(m_1, w_1)$ if $w_1 = m_1$.

When F sells inputs to $D2$ at prices higher than marginal cost, it has less incentive to cut its price in D, since its lower price will reduce its rival's output and hence the rival's purchase of inputs. Thus, *vertical integration changes the pricing incentive of the integrated firm in the downstream market.* This in turn raises both F and $D2$'s prices in D. In terms of reaction functions (curves), the third term on the left-hand side of (5) shifts to the right the reaction curve defined by equation (1) for $i = 1$, causing an upward movement of equilibrium prices. But if $w_1 = m_1$, this effect disappears, since the extra term in (5) is zero. Notice that, in particular, Lemma 1 implies $p_i^F(m_1, m) \geq p_i(m_1, m)$, where the strict inequality holds if and only if $m_1 < m$.

Lemma 2. If $w > m_1$, then $\pi_2^F(m_1, w) > \pi_2(m_1, w)$.

Proof.

$$\pi_2^F(m_1, w) = (p_2^F(m_1, w) - w)q_2(p_1^F(m_1, w), p_2^F(m_1, w))$$
$$> (p_2(m_1, w) - w)q_2(p_1^F(m_1, w), p_2(m_1, w)) \quad \text{(by revealed preference)}$$

[18] Unless otherwise stated, I shall exclude the possible sunk costs of relationship-specific investment in stating a firm's profit. As we shall see later, in equilibrium no firm will incur s by choosing more than one supplier.

$$> (p_2(m_1, w) - w)q_2(p_1(m_1, w), p_2(m_1, w)) \qquad \text{(since } p_1(m_1, w) < p_1^F(m_1, w))$$
$$= \pi_2(m_1, w).$$

Q.E.D.

Lemma 2 says that, for the *same* input price $w > m_1$, $D2$ obtains *higher* profit by purchasing from the integrated firm than from an unintegrated upstream firm. Thus, *vertical integration also changes the incentive of a rival in selecting its input supplier.*

Lemma 3. $\partial \pi_2^F(m_1, w_1)/\partial w_1 < 0$.

Proof.

$$\frac{\partial \pi_2^F(m_1, w_1)}{\partial w_1} = -q_2(p_1^F, p_2^F) + (p_2^F - w_1)\frac{\partial q_2}{\partial p_1}\frac{\partial p_1^F(m_1, w_1)}{\partial w_1} \qquad \text{(by the envelope theorem)}$$
$$= (p_2^F - w_1)\frac{\partial q_2}{\partial p_2} + (p_2^F - w_1)\frac{\partial q_2}{\partial p_1}\frac{\partial p_1^F(m_1, w_1)}{\partial w_1} \qquad \text{(from equation (6))}$$
$$< 0. \qquad \text{(by conditions (3) and (7))}$$

Q.E.D.

It remains to be determined whether $D2$ will purchase from F or from $U2$ in the equilibrium of stage 4. Let us first define $\bar{w}_1$ to be such that

$$\pi_2^F(m_1, \bar{w}_1) = \pi_2(m_1, m). \tag{8}$$

Then $\bar{w}_1$ exists uniquely, since $\pi_2^F(m_1, w_1) \geq \pi_2(m_1, m)$ when $w_1 = m$, $\pi_2^F(m_1, w_1) < \pi_2(m_1, m)$ when w_1 is sufficiently large, and $\partial \pi_2^F(m_1, w_1)/\partial w_1 < 0$. Furthermore, $\bar{w}_1 > m$ if $m_1 < m$ and $\bar{w}_1 = m$ if $m_1 = m$. Note that the difference between $\bar{w}_1$ and m will be small if the difference between m_1 and m is small.

By the envelope theorem, we have

$$\frac{\partial \pi_1^F(m_1, w_1)}{\partial w_1} = \left((p_1^F(m_1, w_1) - m_1)\frac{\partial q_1(p_1^F, p_2^F)}{\partial p_2} + (w_1 - m_1)\frac{\partial q_2(p_1^F, p_2^F)}{\partial p_2}\right)\frac{\partial p_2^F}{\partial w_1} + q_2(p_1^F, p_2^F),$$

which is positive if the difference between w_1 and m_1 is not too large. Therefore, if m_1 is close to m, $\bar{w}_1$ will be close to m and also to m_1. Hence,

$$\frac{\partial \pi_1^F(m_1, w_1)}{\partial w_1} > 0 \qquad \text{for } m_1 \leq w_1 \leq \bar{w}_1, \tag{9}$$

which says that within a certain range, F's profit is higher if $D2$ purchases input from F at a higher price. For the rest of the article I shall assume that condition (9) holds. In our linear-demand example, $\bar{w}_1 = m + (1/2)\beta^2[(m - m_1)/(1 + 2\beta)]$, and condition (9) holds as long as condition (4) is satisfied.

Let us next define, for any $w_1 \geq m$,

$$\hat{\pi}_2(p_1^F(m_1, w_1), m) = \max_{p_2}(p_2 - m)q_2(p_1^F(m_1, w_1), p_2). \tag{10}$$

That is, starting from a potential equilibrium where F chooses $p_1^F(m_1, w_1)$ while $D2$ purchases input from F at w_1 and chooses $p_2^F(m_1, w_1)$, $\hat{\pi}_2(p_1^F(m_1, w_1), m)$ is $D2$'s profit when it deviates to purchasing from $U2$ at $w_2 = m$ and chooses p_2 optimally. Thus, $\hat{\pi}_2(p_1^F(m_1, m), m) = \pi_2^F(m_1, m)$, and $\hat{\pi}_2(p_1^F(m_1, w_1), m)$ increases in w_1, since $p_1^F(m_1, w_1)$ increases in w_1. For any given $m_1 < m$, define $\bar{s}$ to be such that

$$\pi_2^F(m_1, \bar{w}_1) + \bar{s} = \hat{\pi}_2(p_1^F(m_1, \bar{w}_1), m). \tag{11}$$

Then $\bar{s}$ exists uniquely and $\bar{s} > 0$, since $\bar{w}_1 > m$ when $m_1 < m$ and

$$\pi_2^F(m_1, \bar{w}_1) < \pi_2^F(m_1, m) = \hat{\pi}_2(p_1^F(m_1, m), m) < \hat{\pi}_2(p_1^F(m_1, \bar{w}_1), m).$$

Further, for any $s > \bar{s}$, define $w_1(s)$ to be $\bar{w}$, and for any $0 \leq s \leq \bar{s}$, define $w_1(s)$ to be such that

$$\pi_2^F(m_1, w_1(s)) + s = \hat{\pi}_2(p_1^F(m_1, w_1(s)), m). \tag{12}$$

That is, for $s \leq \bar{s}$, $w_1(s)$ ($\geq m$) is such that $D2$ will just not switch to $U2$ if it has chosen F as its sole supplier at stage 3, given $w_2 = m$ and $p_1^F(m_1, w_1(s))$.

If $s = 0$, (12) holds only with $w_1(s) = m$; if $s = \bar{s}$, (12) holds only with $w_1(s) = \bar{w}_1$; and if $0 < s < \bar{s}$, $w_1(s)$ is higher with higher s. Thus we have the following:

Lemma 4. For any given $m_1 < m$ and $s < \bar{s}$, $w_1(s)$ increases in s, with $w_1(0) = m$ and $w_1(\bar{s}) = \bar{w}_1$.

By the construction of $w_1(s)$, since in equilibrium $D2$'s purchase of inputs must be optimal at stage 4 given the downstream price of F, we have the following:

Lemma 5. In equilibrium of stage 4,

(i) if $D2$ has chosen either no supplier or both F and $U2$ at stage 3, it purchases from the supplier with the lower price;

(ii) if $D2$ has chosen only F at stage 3, where $w_1 \leq w_1(s)$ and $w_2 \geq m$, it purchases from F;

(iii) if $D2$ has chosen only F at stage 3 but $w_1 > w_1(s)$, $s \leq \bar{s}$, and w_2 is equal or sufficiently close to m, it purchases from $U2$; and

(iv) if $D2$ has chosen only $U2$ at stage 3 and $w_1 \geq w_2$, it purchases from $U2$.

□ **The upstream market with vertical merger of *D*1 and *U*1.** I now study equilibrium in the upstream market when only $D1$ and $U1$ have vertically integrated. We have the following:

Proposition 1. In the subgame where F is formed through the $D1$-$U1$ merger and no other merger has occurred, the unique equilibrium outcome is that (i) if $m > m_1$, then $w_1^* = w_1(s)$, $D2$ purchases only from F, and, if $s > 0$, $D2$ chooses F at stage 3; and (ii) if $m = m_1$, then $w_1 = w_2 = m$, $D2$ purchases from either F or $U2$, and, if $s > 0$, $D2$ chooses only one supplier.

Proof. See the Appendix.

Therefore, if $m > m_1$, $w_1(s)$ will be such that $D2$ is just indifferent between choosing F as its only supplier or choosing $U2$ as its only supplier at $w_2 = m$, and $w_1(s) > m$ if and only if $s > 0$.[19] But if $m = m_1$, F will not be able to sell to $D2$ at $w_1 > m$, regardless of the value of s.[20]

□ **Will there be any countermerger if *D*1 and *U*1 merge?** If $D2$ counters the merger of $D1$ and $U1$ by a merger of its own with an upstream firm, say $U2$, the combined profit of $D2$ and $U2$ would be $\pi_2(m_1, m)$. But since $w_1^* = w_1(s) \leq \bar{w}_1$, $\pi_2^F(m_1, \bar{w}_1) = \pi_2(m_1, m)$, and $\pi_2^F(m_1, w_1)$ is higher with lower w_1, we must have $\pi_2^F(m_1, w_1^*) \geq \pi_2(m_1, m)$, implying that $D2$ and $U2$ cannot benefit from their own merger. Therefore, in equilibrium, there will be no countermerger if $D1$ and $U1$ merge.

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[19] Note that since upstream firms announce their prices before downstream firms incur any relationship-specific investment, the problem of supplier opportunism does not arise here, and in equilibrium there is no incentive for a downstream firm to source from several suppliers.

[20] It is not true that $D2$ would always choose F if w_1 is only slightly higher than m. When $D2$ purchases from F at $w_1 > m$ instead of from $U2$ at $w_2 = m$, it benefits from the collusive (strategic) effect but suffers from increased input cost. If $m_1 = m$, the cost effect outweighs the strategic effect.

□ **Equilibrium vertical merger.** After a vertical merger by a downstream firm with $U1$, the unintegrated D firm will receive $\pi_2^F(m_1, w_1^*)$, with $\pi_2(m_1, m) = \pi_2^F(m_1, \bar{w}_1) \leq \pi_2^F(m_1, w_1^*) \leq \pi_2^F(m_1, m)$. Competition between the downstream firms implies that $D1$ will need to pay $\pi_1^F(m_1, w_1^*) - \pi_2^F(m_1, w_1^*)$ to acquire $U1$. Since without the merger $U1$ can obtain

$$(m - m_1)\left[q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))\right],$$

we have the folowing:

Lemma 6. In equilibrium, there is vertical merger by $D1$ and $U1$ if and only if

$$\pi_1^F(m_1, w_1^*) > \pi_2^F(m_1, w_1^*) + (m - m_1)\left[q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))\right].$$

The next lemma says that a vertical merger will make the downstream market more competitive if it does not raise the rival's cost ($w_1^* = m$).

Lemma 7. $p_1^F(m_1, m) \leq p_2^F(m_1, m) \leq p_1(m, m) = p_2(m, m)$, where the strict inequalities hold if and only if $m_1 < m$.

Proof. See the Appendix.

With Lemma 6 and Lemma 7, I can establish my main result:

Theorem 1. There is vertical merger in equilibrium if and only if $m_1 < m$.

Proof. See the Appendix.

4. The competitive effects of vertical mergers

■ *Proposition 2.* A vertical merger of $D1$ with $U1$ reduces the market share and the profit of $D2$. Furthermore, it raises the input price of $D2$ if and only if $s > 0$.

Proof. See the Appendix.

Therefore, although it will purchase inputs from F given that $D1$ and $U1$ have merged, $D2$ would prefer that no merger had occurred, since its profit is reduced by the merger.

As in OSS and other models of vertical foreclosure, a vertical merger in my theory can have an anticompetitive effect, but it is for a reason that has not been identified in the literature: vertical integration changes a downstream producer's pricing incentive, due to its becoming a supplier to its rival. This in turn softens price competition in the final market and changes the rival's incentive in selecting input suppliers. I shall call this the *collusive effect* of vertical mergers.

Although it will have a collusive effect, a vertical merger in my model can occur if and only if it yields a certain efficiency gain ($m_1 < m$): either the downstream firm integrates a more efficient upstream producer and eliminates the inefficiency from double markup, or the vertical merger improves efficiency in the production of inputs by $U1$. In either case, the integrated firm will face a lower marginal cost in producing the final good. This in turn intensifies price competition in the final market and tends to make vertical integration procompetitive. I shall call this the *efficiency effect* of vertical mergers.

Which effect dominates depends on the cost of switching suppliers and the degree of downstream product differentiation. Notice that w_1^* increases in s when $s \leq \bar{s}$, $w_1^* = m$ when $s = 0$, and $p_i^F(m_1, w_1^*)$ increases in w_1^* for $i = 1, 2$. But since $p_1^F(m_1, m) < p_2^F(m_1, m) < p_1(m, m) = p_2(m, m)$, we must have the following:

Proposition 3. If s is equal or sufficiently close to zero, a vertical merger lowers prices in D and benefits consumers.

Because F has less incentive to cut downstream prices when it supplies $D2$ at $w_1 > m_1$, it may be in $D2$'s interests to choose F as its supplier even when F's price is higher than the competitive level. But once F's downstream price is given, $D2$ has an incentive to switch suppliers if relationship-specific investment is low. In equilibrium, $w_1^* = w_1(s)$ will decrease as s decreases, with $w_1(0) = m$. Thus, if s is small, a vertical merger will have little effect on the rival's cost. As a result, the vertical merger will lower prices in D and benefit consumers.

When s is substantial, the cost for $D2$ to switch suppliers is high. This increases F's ability to raise the input price of $D2$, which can be as high as $w_1^* = \bar{w}_1$. Interestingly, in this case the simple and familiar measure for the degree of product differentiation, $\partial q_2/\partial p_1$, can then be used to evaluate the competitive effects.

Proposition 4. Assume that $s \geq \hat{s}$ for any given $\hat{s} > 0$. Then, a vertical merger lowers downstream prices if

$$\frac{\partial q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*))}{\partial p_1}$$

is sufficiently small, and it increases downstream prices if

$$\frac{\partial q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*))}{\partial p_1}$$

is sufficiently large.

Proof. See the Appendix.

Thus, when downstream firms are close competitors (produce close substitutes), the collusive effect tends to dominate and the vertical merger tends to be anticompetitive; but if products are highly differentiated, the efficiency effect tends to dominate and the vertical merger tends to be procompetitive.

In our linear-demand example,

$$\begin{aligned}\bar{s} = &\frac{(1+\beta)\,\beta^2\,(m-m_1)}{16\,(3\beta+2)\,(2+\beta)\,(1+2\beta)^2}\\ &\times \left[\left(3\beta^2+10\beta+4\right)\left(\beta^2-6\beta-4\right)m + 16 + \left(20\beta^2+8\beta+8\beta^3-3\beta^4\right)m_1\right.\\ &\qquad \left. +48\beta^2+56\beta\right].\end{aligned}$$

If we also assume[21]

$$m \leq m_1 + (1-m_1)\,\frac{(1+2\beta)\,(2+3\beta)\left(3\beta^2+6\beta+4\right)}{(1+\beta)^2\left(9\beta^2+16\beta+8\right)\left(2+4\beta+\beta^2\right)},$$

and $m_1 = 0$, then $\bar{s} \leq 3.4785 \times 10^{-2}$. We then find that, for any $s \geq 3.4785 \times 10^{-2}$ (which implies that $w_1^* = \bar{w}_1$, independent of s), vertical merger lowers final prices if $\beta < .74827$, and it raises final prices if $\beta > 1.8414$. When $.74827 < \beta < 1.8414$, the merger lowers the price for product 1 but raises the price for product 2.

This analysis can shed light on recent cases of vertical mergers. In many of the recent (proposed) vertical mergers, a major concern raised by antitrust agencies has been that the vertically integrated firm would increase its input price to the downstream competitors and thus reduce competition. For instance, in its 1999 investigation into the proposed vertical merger between book retailer Barnes & Noble and wholesaler Ingram, the Federal Trade Commission was concerned that the merged firm would raise wholesale prices to the competitors of Barnes & Noble in the retail market. In its 1994 enforcement action concerning the vertical merger of AT&T and McCaw,

[21] The tighter requirement on m here ensures that when β is large and increases, m goes to m_1 sufficiently fast so that $\bar{s}$ approaches zero. It is a sufficient but not necessary condition for the analysis. The assumption that $m_1 = 0$ is made for ease of calculation.

the U.S. Department of Justice reasoned that AT&T, a major producer of telecommunications equipment, would raise prices to McCaw's competitors in the cellular business after the vertical merger.[22] However, the incentive for an upstream firm to raise price may have existed even before its vertical integration with a downstream firm, and it is quite possible that the upstream firm's market power has been contained by (potential) competition from other upstream producers. Thus, the real question may not be whether an upstream firm has the incentive to raise its price to a downstream firm, but rather why it is able to do so after vertical integration. My analysis suggests that an integrated firm will have not only the *incentive* but (more importantly) the *ability* to raise input prices to its rival,[23] because vertical integration changes its rival's incentive in choosing suppliers. The concerns of government agencies are thus consistent with the predictions of my model, and a downstream firm, despite its likely reluctance and resentment, might nevertheless be willing to pay a higher price to purchase from the same supplier that is now a vertically integrated firm.[24]

The new theories of vertical foreclosure have mainly focused on the anticompetitive effects of vertical mergers. As such, they are inadequate for providing guidance on evaluating the competitive effects of vertical mergers. Recently, Riordan (1998) has developed an interesting model in which vertical integration can have both efficiency and foreclosure effects, and his analysis yields a clear policy message suggesting that on balance vertical merger is anticompetitive. However, Riordan's analysis is based on and applies only to situations where there is a dominant firm in the downstream market. My results here provide clear policy implications for vertical mergers when the downstream market is an oligopoly.[25]

5. Discussion

■ I now consider several possible changes to the model to gain insights on the robustness of my results.

□ **Quantity competition.** Suppose that everything is the same as before except that the downstream market is characterized by a homogeneous product and quantity competition. Suppose that the (inverse) market demand in D is $P(q_1 + q_2)$, where q_1 and q_2 are the output choices of $D1$ (or F) and $D2$. As before, when D is considered in isolation, let $q_i(c_1, c_2)$ and $\pi_i(c_1, c_2)$ be Di's equilibrium output and profit under constant marginal cost c_i. When $D1$ and $U1$ have vertically integrated, the profits of F and $D2$ are

$$\pi_1^F = q_1 \left[P(q_1 + q_2) - m_1\right] + (w_1 - m_1)q_2,$$
$$\pi_2^F = q_2 \left[P(q_1 + q_2) - w_1\right].$$

If F competes with $D2$ in Cournot fashion, then since q_2 is taken as given when F chooses its output in D, in equilibrium $q_1^F(m_1, w_1)$ and $q_2^F(m_1, w_1)$ solve

$$P(q_1^F + q_2^F) - m_1 + q_1^F \frac{\partial P(q_1^F + q_2^F)}{\partial q_1} = 0,$$
$$P(q_1^F +, q_2^F) - w_1 + q_2^F \frac{\partial P(q_1^F + q_2^F)}{\partial q_2} = 0.$$

[22] Notice that, contrary to the usual scenario of vertical foreclosure in which the integrated firm ends up not supplying the rival, here the integrated firm would probably continue to supply its rivals.

[23] There appear to be nontrivial relationship-specific sunk costs between upstream and downstream firms in these and many other cases.

[24] Firms may not reveal their strategic motives for legal reasons, inputs from different suppliers may differ, and integrated firms are sometimes legally required not to raise input prices to rivals. All these factors make it difficult to empirically test the predictions of my model.

[25] Riordan also finds that vertical integration may or may not reduce social welfare. It appears that the same can also be said here, although a detailed welfare analysis is beyond the scope of this article.

But these are the same equilibrium conditions if $D2$ purchases from an unintegrated upstream firm at $w_2 = w_1$. Therefore the identity of the supplier will not matter to $D2$ and the equilibrium input price for $D2$ will always be m. By standard results under Cournot competition, in equilibrium, $\pi_2^F(m_1, m) = \pi_2(m_1, m)$, $q_2^F(m_1, m) = q_2(m_1, m) \leq q_2(m, m) \leq q_1(m_1, m) = q_1^F(m_1, m)$, and $q_1(m, m) + q_2(m, m) \leq q_1^F(m_1, m) + q_2^F(m_1, m)$, where the inequalities hold strictly if and only if $m_1 < m$. By revealed preference, we can easily show

$$\pi_1^F(m_1, m) \geq \pi_2^F(m_1, m) + (m - m_1)\left[q_1(m, m) + q_2(m, m)\right],$$

where the inequality holds strictly if and only if $m_1 < m$. Thus, from Lemma 6 with $w_1^* = m$, there is vertical merger if and only if $m_1 < m$. Furthermore, it can easily be verified that $\pi_2^F(m_1, m) < \pi_2(m, m)$ if $m_1 < m$. We therefore have the following:

Remark 1. If my model is changed so that in the downstream market there is a homogeneous product and firms are Cournot competitors, then it continues to be true that there is equilibrium vertical merger if and only if $m_1 < m$, and it also continues to be true that the vertical merger reduces the downstream rival's market share and its profit. However, here the vertical merger always benefits consumers.

The collusive effect does not arise in the Cournot model, since F does not take into account that its more aggressive action in D may reduce $D2$'s output and its purchase of input from F. But if an integrated firm should realize that its strategic actions in the downstream market could affect its profit in the upstream market, then the Cournot model would seem inappropriate.

Even with quantity competition, if we allow F (and $D1$) to be a Stackelberg leader in D, then F would incorporate the effect of its strategic action in D on its profit in U, and the collusive effect of vertical merger can again arise. Therefore, whether a vertical merger will lead to collusive behavior depends crucially on whether the integrated firm will take its rival's output as given in making its strategic decisions in the downstream market. This is why a vertical merger has a collusive effect under Bertrand or Stackelberg competition, but not in the Cournot model.

□ **No discrimination in the upstream market.** My analysis allows the possibility that a downstream firm purchases inputs from a supplier that does not offer the lowest price. Suppose instead that a downstream firm is required by law to purchase input from any supplier with the lowest price. Then in equilibrium F will set $w_1 = m$ in order to sell to $D2$, and $D2$ will indeed purchase from F if $m_1 < m$.[26] Everything will then be the same as in the model under $s = 0$. We therefore have the following:

Remark 2. If firms in D are required by law to purchase from any supplier with the lowest price, then Theorem 1 again holds; i.e., there is vertical merger in equilibrium if and only if $m_1 < m$. However, here a vertical merger benefits consumers.

In equilibrium, $D2$ will purchase input from F at $w_1 = m$ and the final prices are higher than they would be if $D2$ purchased from an unintegrated U firm at the same input price, because F's concern for its upstream profit softens competition in the downstream market. In this sense, the collusive effect of vertical merger still exists. But the final prices are lower than they would be had no vertical merger occurred, due to the dominating efficiency effect.

□ **Two-part tariffs and requirement contracts.** In this model I have assumed that transactions in the upstream market are governed by linear prices announced by upstream firms at stage 3. I now extend the model to allow more generally two-part tariffs (w, T). If only $T \geq 0$ is allowed, we have the usual form of two-part tariffs where the buyer pays a nonnegative fixed fee together with a unit price. In this case, the analysis will not be affected by the use of two-part

[26] $D2$ would be indifferent between purchasing from F or $U2$ at price m, but the only strategy of $D2$ that is consistent with equilibrium is for it to purchase from F if $m_1 < m$.

tariffs. This is because if in equilibrium an upstream firm offers (w, T) with $T > 0$, by reducing T and properly increasing w, it will continue to sell to the downstream firms that would purchase under the original two-part tariffs, but the joint profits of the upstream firm and its downstream purchasers will be higher.[27] Thus in equilibrium $T = 0$ for any active upstream producer. This differs from the result in Bonanno and Vickers (1988), who consider a model with two manufacturers choosing to sell their products either by themselves (vertical integration) or through retailers (vertical separation). They find that in equilibrium, each firm chooses vertical separation, charging its retailer $T > 0$ and a wholesale price above marginal cost. The reason for the difference is that in their model, each manufacturer (supplier) has monopoly power over its retailer,[28] while here the upstream firms compete to supply to the downstream firms. Thus in their setting, when a manufacturer sells through a retailer with a wholesale price above marginal cost, the competition of its rival is softened. But here, an upstream firm charging $T > 0$ has to lower w in order to sell to a downstream firm.

If $T < 0$ is allowed, we will still have $T = 0$ in equilibrium if $s = 0$. This is because when $T < 0$, $-T$ represents the transfer payment from the upstream firm to a purchasing downstream firm. Since the downstream firm can obtain $-T$ by purchasing an infinitely small amount, it will purchase a nonnegligible amount only if it is offered an attractive w. But then the upstream firm cannot be optimizing by setting any $T < 0$. If $s > 0$, however, it is possible that $U1$ could pay $D1$ and $D2$ certain $-T > 0$ for them to purchase from it at a price $w > m$, achieving some collusion.[29] It is then not clear whether vertical merger will still occur in equilibrium. Nevertheless, similarly to the case of $s = 0$, we must have $-T \leq s$ in equilibrium. This implies that if s is sufficiently small, allowing $T < 0$ will have little effect on the equilibrium profits of all parties in my model, and hence my results will continue to hold.

To summarize, we have the following:

Remark 3. If any input supplier is not allowed to make transfer payments to its customer(s), the use of two-part tariffs will not change my analysis; otherwise, a sufficient condition under which two-part tariffs do not change my results is $s = 0$.

Another possible extension of my model is to allow the use of requirement contracts in the input market, under which a downstream firm is required to purchase all inputs from a certain supplier at some unit price. In early versions of this article I did consider requirement contracts in the basic model. Theorem 1 and my finding that vertical mergers involve both efficiency and collusive effects both hold under this alternative setting. With requirement contracts, however, a vertical merger can be anticompetitive even if $s = 0$. In fact, the results under requirement contracts with any $s \geq 0$ will be the same as the results in the special case of my model where $s \geq \bar{s}$. Intuitively, a requirement contract creates a large (infinite) switching cost for a downstream firm (even if $s = 0$), resulting in the same outcomes as those in my model when s is sufficiently large. This again suggests that the cost of switching suppliers, whether it is due to the presence of relationship-specific investment or to contract commitments, is an important determinant of the competitive effects of vertical mergers. However, my focus on specific investment instead of contract commitments as the source of switching costs is more satisfactory from a modelling perspective. It means that my results are not due to arbitrary contract commitments, thus avoiding a major criticism of the OSS model. My model is more natural, since relationship-specific investment is fairly common while requirement contracts may not be; further, it produces results that are continuous as a function of s, allowing $s = 0$.

[27] If it supplies to both downstream firms, this is obviously true. This is also true if it only supplies to one downstream firm, since when it raises w, it causes the other downstream firm's price to rise.

[28] A retailer can purchase only from its own manufacturer, and the manufacturer extracts all the surplus through T.

[29] This is essentially an upstream firm "bribing" a downstream firm to purchase from it at an inflated price, and it may not be feasible in practice due to antitrust enforcement.

□ **Comparison with horizontal mergers.** There are obvious similarities between my model of vertical mergers and models of horizontal mergers. My result that vertical mergers occur in equilibrium if and only if there are efficiency gains is closely related to the results in Farrell and Shapiro (1990) and Salant, Switzer, and Reynolds (1983), where equilibrium horizontal mergers can occur only if there are efficiency gains. The results in these two articles, however, depend on there being Cournot competition, and as Davidson and Deneckere (1985) have shown, with Bertrand competition no efficiency gain is needed to cause a horizontal merger. The result in my model is stronger in the sense that it holds for both Bertrand and Cournot competition.

My result that vertical mergers tend to have both collusive and efficiency effects is closely related to the result in the literature that horizontal mergers often have these two effects. The competitive effects of vertical mergers therefore involve tradeoffs somewhat similar to those in horizontal mergers. Vertical mergers tend to be procompetitive when the downstream firms' products are highly differentiated, but anticompetitive when they are close substitutes (provided that there are positive costs of switching suppliers). This finding is parallel to the results in the horizontal merger literature regarding how the competitive effects of horizontal mergers may depend on product differentiation, which is reflected in the evaluation of horizontal mergers by the U.S. Department of Justice and FTC (see in particular Section 2.21 in the 1992 Horizontal Merger Guidelines by the Justice Department and the FTC).

6. Conclusion

■ The new theories of vertical mergers have offered the important insight that vertical integration changes an upstream producer's pricing incentive. This article suggests that vertical integration may also change a downstream producer's pricing incentive and its rivals' incentive in choosing input suppliers. With this new insight, I have developed an equilibrium theory of vertical mergers, incorporating the strategic behaviors in both the upstream and downstream markets. My main result has a very simple form: Under fairly general conditions, equilibrium vertical mergers occur if and only if $m_1 < m$. This result in turn implies that vertical mergers will generally lead to both an efficiency gain and collusive behavior in horizontal competition. Whether the efficiency or the collusive effect dominates depends on the cost of switching suppliers and the degree of product differentiation. When relationship-specific investment is small (or the input market closely resembles a spot market), it is easy for a downstream firm to change suppliers, and a vertical merger tends to benefit consumers. When there is a substantial cost to switch suppliers, a vertical merger tends to benefit consumers if there is significant downstream product differentiation, but it tends to harm consumers if the downstream products are close substitutes.

In my theory, a vertical merger can raise downstream rivals' cost, not because the rivals are excluded from input suppliers, but because the merger changes the rivals' incentive in selecting input suppliers. A vertical merger creates the opportunity for multimarket interdependence between competitors in the downstream market and will thus have a collusive effect.[30] However, this collusive effect can be realized if and only if the vertical merger also has an efficiency effect due to lowered marginal cost of the integrated firm in producing the final product. It is generally believed that a firm can obtain competitive advantage either by cutting its own cost or by raising rivals' cost, and only the latter type of strategies is considered anticompetitive (Klass and Salinger, 1995). My analysis suggests that these two strategies may be intrinsically related in some situations: a firm can raise rivals' cost through vertical integration if and only if its own cost is reduced through the integration.

There are other approaches to the study of vertical integration. One is based on the notion of incomplete contracts, as in Grossman and Hart (1986), Hart and Tirole (1990), and Williamson (1985). Another approach has focused more on problems of asymmetric information, as in Arrow

[30] That multimarket contacts may facilitate collusion has been formally modelled in Bernheim and Whinston (1990) in the context of repeated interactions. My analysis suggests that such considerations can also be important in a vertical context, without the need for repeated interactions.

(1975) and Gal-Or (1999). My focus on horizontal competition and vertical merger is complementary to these alternative approaches. The idea that vertical integration changes the strategic incentives of both the integrated firm and its rivals may have broader implications beyond the theory of vertical mergers developed in this article. It may also help us understand more generally how horizontal competition affects and is affected by the vertical organization of industries.[31] This remains an interesting area for future research.

Appendix

■ Proofs of Propositions 1, 2, and 4, Lemma 7, and Theorem 1 follow.

Proof of Proposition 1. (i) First, by construction, the strategies of F setting w_1^*, all unintegrated U firms setting $w_2^* = m$, and $D2$ choosing F at stage 3 as its only supplier when $w_1 \leq w_1(s)$ constitute an equilibrium of the subgame, where at stage 4 the prices of F and $D2$ are $p_1^F(m_1, w_1^*)$ and $p_2^F(m_1, w_1^*)$ and $D2$ purchases from F. Thus what is proposed is an equilibrium outcome. Next, there can be no equilibrium where $w_1 > w_1^* = w_1(s)$. This is because if $w_1(s) = \bar{w}_1$, $w_1 > \bar{w}_1$ implies that $\pi_2^F(m_1, w_1) < \pi_2(m_1, m)$. Hence $D2$ would prefer to choose and purchase from $U2$ if w_2 is equal to or slightly higher than m, and such a price will indeed be offered. But then F can increase its profit by offering w_1 at slightly below $\bar{w}_1$, selling to $D2$. If $w_1(s) < \bar{w}_1$, then $s < \bar{s}$, and $w_1 > w_1(s)$ implies that there is no equilibrium where $D2$ purchases from F at stage 4 when w_2 is equal to or slightly higher than m. But then F can increase its profit by lowering w_1 to $w_1(s)$, selling to $D2$. It can also easily be shown that there can be no equilibrium where $w_1 < w_1^*$, since F can then increase its profit by raising w_1 to w_1^*. Finally, there can be no equilibrium if $D2$'s behavior is such that it chooses $U2$ as its supplier when $w_1 = w_1(s)$ and $w_2 = m$. There can also be no equilibrium where $D2$ does not choose F at stage 3, when $w_1 = w_1^* > m = w_2$. Thus other possible equilibria can differ from the proposed one only in that one or several unintegrated U firms may offer $w > m$ or that, if $s = 0$, it does not matter when $D2$ chooses its supplier. But the equilibrium outcome is always for F to offer w_1^* and $D2$ purchases only from F.

(ii) If $m = m_1$, then $\pi_2^F(m_1, m) = \pi_2(m_1, m)$, and hence $w_1^* = \bar{w}_1 = m$. In this case, it is an equilibrium for F and unintegrated U firms to charge m and for $D2$ to choose either F or an unintegrated upstream firm. For similar arguments as in (i), at any equilibrium at least two upstream producers, including possibly F, must offer $w_2 = m$ (or $w_1 = m$) to $D2$, and $D2$ will choose only one supplier if $s > 0$. Hence the proposed is the unique equilibrium outcome. *Q.E.D.*

Proof of Lemma 7. $p_1^F(m_1, m)$ and $p_2^F(m_1, m)$ satisfy

$$(p_1 - m)\frac{\partial q_1(p_1, p_2)}{\partial p_1} + q_1(p_1, p_2) + (m - m_1)\left[\frac{\partial q_1(p_1, p_2)}{\partial p_1} + \frac{\partial q_2(p_1, p_2)}{\partial p_1}\right] = 0,$$

$$(p_2 - m)\frac{\partial q_2(p_1, p_2)}{\partial p_2} + q_2(p_1, p_2) = 0.$$

If $m_1 = m$, then these conditions would be the same as those for $p_1(m, m)$ and $p_2(m, m)$ in condition (1), and we would have $p_i^F(m_1, m) = p_i(m, m)$. If $m_1 < m$, then since

$$\frac{\partial q_1(p_1, p_2)}{\partial p_1} + \frac{\partial q_2(p_1, p_2)}{\partial p_1} < 0$$

from condition (3), we have

$$(p_1^F(m_1, m) - m)\frac{\partial q_1(p_1, p_2)}{\partial p_1} + q_1(p_1^F(m_1, m), p_2^F(m_1, m)) > 0,$$

$$(p_2^F(m_1, m) - m)\frac{\partial q_2(p_1, p_2)}{\partial p_2} + q_2(p_1^F(m_1, m), p_2^F(m_1, m)) = 0.$$

Comparing these conditions with those for $p_i(m, m)$ in condition (1), we have $p_1^F(m_1, m) < p_2^F(m_1, m) < p_1(m, m) = p_2(m, m)$. *Q.E.D.*

Proof of Theorem 1. If $m = m_1$, then

$$\pi_1^F(m_1, w_1^*) - \left[\pi_2^F(m_1, w_1^*) + (m - m_1)\left(q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))\right)\right]$$
$$= \pi_1^F(m, m) - \pi_2^F(m, m) = \pi_1(m, m) - \pi_2(m, m) = 0.$$

[31] In a model with economies of scale in upstream production, Chen (2001) shows that the strategic purchasing behavior of downstream rivals may also motivate a firm to vertically disintegrate.

Hence, from Lemma 6, there is no vertical merger if $m = m_1$. Thus we need only show there is vertical merger if $m_1 < m$. We proceed as follows.

Step 1. Notice $\pi_1^F(m_1, w_1^*) \geq \pi_1^F(m_1, m)$ due to $w_1^* \geq m$ and condition (9).

Step 2.

$$\begin{aligned} & q_1(p_2^F(m_1, m), p_2^F(m_1, m)) + q_2(p_2^F(m_1, m), p_2^F(m_1, m)) \\ & \quad = q_1(p_1(m, m), p_2^F(m_1, m)) + q_2(p_1(m, m), p_2^F(m_1, m)) \\ & \qquad + \int_{p_1(m,m)}^{p_2^F(m_1,m)} \left(\frac{\partial q_1(p_1, p_2^F(m_1, m))}{\partial p_1} + \frac{\partial q_2(p_1, p_2^F(m_1, m))}{\partial p_1} \right) dp_1 \\ & \quad > q_1(p_1(m, m), p_2^F(m_1, m)) + q_2(p_1(m, m), p_2^F(m_1, m)), \end{aligned}$$

since

$$\frac{\partial q_1(p_1, p_2^F(m_1, m)}{\partial p_1} + \frac{\partial q_2(p_1, p_2^F(m_1, m)}{\partial p_1} < 0$$

and $p_2^F(m_1, m) < p_2(m, m) = p_1(m, m)$.

Step 3.

$$\begin{aligned} & q_1(p_1(m, m), p_2^F(m_1, m)) + q_2(p_1(m, m), p_2^F(m_1, m)) \\ & \quad = q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m)) \\ & \qquad + \int_{p_2(m,m)}^{p_2^F(m_1,m)} \left(\frac{\partial q_1(p_1(m, m), p_2)}{\partial p_2} + \frac{\partial q_2(p_1(m, m), p_2)}{\partial p_2} \right) dp_2 \\ & \quad > q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m)), \end{aligned}$$

since

$$\frac{\partial q_1(p_1(m, m), p_2)}{\partial p_2} + \frac{\partial q_2(p_1(m, m), p_2)}{\partial p_2} < 0$$

and $p_2^F(m_1, m) < p_2(m, m)$.

Step 4.

$$\begin{aligned} & \pi_1^F(m_1, m) \\ & \quad = (p_1^F(m_1, m) - m_1)q_1(p_1^F(m_1, m), p_2^F(m_1, m)) + (m - m_1)q_2(p_1^F(m_1, m), p_2^F(m_1, m)) \\ & \quad > (p_2^F(m_1, m) - m)q_1(p_2^F(m_1, m), p_2^F(m_1, m)) && \text{(by revealed preference)} \\ & \qquad + (m - m_1)\Big[q_1(p_2^F(m_1, m), p_2^F(m_1, m)) + q_2(p_2^F(m_1, m), p_2^F(m_1, m))\Big] \\ & \quad > (p_2^F(m_1, m) - m)q_1(p_2^F(m_1, m), p_1^F(m_1, m)) && \text{(since } p_1^F(m_1, m) < p_2^F(m_1, m)) \\ & \qquad + (m - m_1)\left[q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))\right]. && \text{(from steps 2 and 3)} \end{aligned}$$

Then, since

$$\begin{aligned} & (p_2^F(m_1, m) - m)q_1(p_2^F(m_1, m), p_1^F(m_1, m)) \\ & \quad = (p_2^F(m_1, m) - m)q_2(p_1^F(m_1, m), p_2^F(m_1, m)) = \pi_2^F(m_1, m), \end{aligned}$$

we have

$$\pi_1^F(m_1, m) > \pi_2^F(m_1, m) + (m - m_1)\left[q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))\right].$$

Our conclusion follows from $\pi_1^F(m_1, w_1^*) \geq \pi_1^F(m_1, m)$, $\pi_2^F(m_1, m) \geq \pi_2^F(m_1, w_1^*)$, and Lemma 6. *Q.E.D.*

Proof of Proposition 2. First, since a merger of $D1$ and $U1$ occurs only if $m > m_1$, we have $w_1^* \geq m > m_1$. By an argument similar to that in the proof of Lemma 7, we have $p_1^F(m_1, w_1{}^*) < p_2^F(m_1, w_1^*)$, and thus

$$q_1(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*)) > q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*)).$$

But

$$q_1(p_1(m,m), p_2(m,m)) = q_2(p_1(m,m), p_2(m,m)).$$

Therefore the merger of $D1$ and $U1$ reduces the market share of $D2$. Second,

$$\begin{aligned}\pi_2^F(m_1, w_1^*) \le \pi_2^F(m_1, m) &= \left(p_2^F(m_1, m) - m\right) q_2\left(p_1^F(m_1, m), p_2^F(m_1, m)\right)\\ &< \left(p_2^F(m_1, m) - m\right) q_2\left(p_1(m, m), p_2^F(m_1, m)\right)\\ &< (p_2(m,m) - m)\, q_2\,(p_1(m,m), p_2(m,m)) = \pi_2(m,m),\end{aligned}$$

where the last two inequalities are due to $p_1^F(m_1, m) < p_1(m,m)$ and $D2$'s revealed preference.

Finally, since $w_1^* > m$ if and only if $s > 0$, the merger of $D1$ and $U1$ raises the input price for $D2$ if and only if $s > 0$. *Q.E.D.*

Proof of Proposition 4. Notice first that

$$\frac{\partial^2 \pi_2^F(m_1, w_1)}{\partial w_1 \partial\left(\frac{\partial q_2}{\partial p_1}\right)} = (p_2^F - w_1)\frac{\partial p_1^F(m_1, w_1)}{\partial w_1} > 0.$$

Therefore, since $\bar{w}_1$ solves $\pi_2^F(m_1, \bar{w}_1) = \pi_2(m_1, m)$, $\bar{w}_1$ increases in $\partial q_2/\partial p_1$. Notice also that if $\partial q_2/\partial p_1 = 0$, $\bar{w}_1 = m$. Next, $p_1^F(m_1, w_1^*)$ and $p_2^F(m_1, w_1^*)$ satisfy

$$\begin{aligned}(p_1^F(m_1, w_1^*) - m_1)\frac{\partial q_1(p_1, p_2)}{\partial p_1} + q_1(p_1^F, p_2^F) + (w_1^* - m_1)\frac{\partial q_2(p_1, p_2)}{\partial p_1} &= 0,\\ (p_2^F(m_1, w_1^*) - w_1^*)\frac{\partial q_2}{\partial p_2} + q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*)) &= 0.\end{aligned}$$

If $\partial q_2/\partial p_1 = 0$, we would have $w_1^* = \bar{w}_1 = m$ and hence, from Lemma 7 and $m_1 < m$, we would have $p_2^F(m_1, w_1^*) = p_2(m_1, m) < p_2(m,m)$, Therefore, if

$$\frac{\partial q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*))}{\partial p_1}$$

is sufficiently close to zero, $\bar{w}_1$ and hence w_1^* could be arbitrarily close to m and we would have $p_1^F(m_1, w_1^*) < p_2^F(m_1, w_1^*) < p_2(m,m) = p_1(m,m)$. On the other hand, recall that $w_1(s)$ solves

$$\pi_2^F(m_1, w_1(s)) + s = \hat{\pi}_2(p_1^F(m_1, w_1(s)), m),$$

and $\pi_2^F(m_1, m) = \hat{\pi}_2(p_1^F(m_1, m), m)$. Thus, for any given $m_1 < m$ and any given $\hat{s} > 0$, there must exist some $\hat{w}_1 > m$ such that $\hat{w}_1 \le w_1(s) \le \bar{w}_1$ for any $s \ge \hat{s}$ and any given $\partial q_2/\partial p_1 > 0$. This, together with the fact that $\bar{w}_1 > m$ and $\bar{w}_1$ increases in $\partial q_2/\partial p_1$, implies that $w_1^* = w_1(s) \ge m + \delta$ when $\partial q_2/\partial p_1$ is large, for some constant $\delta > 0$. Thus if $\partial q_2/\partial p_1$ is large enough to be sufficiently close to $-\partial q_1/\partial p_1$, we would have

$$(m - m_1)\frac{\partial q_1(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*))}{\partial p_1} + (w_1^* - m_1)\frac{\partial q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*))}{\partial p_1} > 0,$$

and thus

$$\begin{aligned}(p_1^F(m_1, w_1^*) - m)\frac{\partial q_1}{\partial p_1} + q_1(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*)) &< 0,\\ (p_2^F(m_1, w_1^*) - w_1^*)\frac{\partial q_2}{\partial p_2} + q_2(p_1^F(m_1, w_1^*), p_2^F(m_1, w_1^*)) &= 0,\end{aligned}$$

which implies that $p_2(m,m) = p_1(m,m) < p_1^F(m_1, w_1^*) < p_2^F(m, w_1^*)$. *Q.E.D.*

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