On Vertical Mergers and Their Competitive Effects

Yongmin Chen*

Department of Economics

University of Colorado at Boulder

Boulder, CO 80309

Phone: (303)492-8736; E-mail: Yongmin.Chen@colorado.edu

April 2000

Abstract. It is well known that vertical integration can change an upstream producer's incentive to supply the integrated firm's downstream rivals. However, it has not been noticed that vertical integration also changes these rivals' incentives to choose suppliers. This paper develops an equilibrium theory of vertical merger that incorporates strategic behaviors in the input market of both the integrated firm and the (downstream) rivals. Under fairly general conditions, vertical mergers will result in both efficiency gains and a collusive effect, and a familiar measure concerning product differentiation can be used to evaluate whether a vertical merger tends to benefit or harm consumers.

Key Words: vertical merger, vertical integration, efficiency, foreclosure, collusion.

* I thank Ig Horstmann, Frank Mathewson, Bob Rosenthal, Tom Rutherford, Marius Schwartz, Ron Smith, Kathy Spier, Ralph Winter, and seminar participants at Northwestern University, Queen's University, University of Colorado at Boulder, and University of Toronto for helpful comments and suggestions. Research support from the National Science Foundation under grant # SES-9911229 is gratefully acknowledged.

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 1950s-70s, viewed vertical merger as harming competition by denying competitors access to either a supplier or a buyer.[1] The foreclosure theory has received strong criticism from authors that are commonly associated with the Chicago School. The critics argue that the theory is logically flawed, and 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 pro-competitive and to more favorable treatment to vertical mergers in antitrust in the 1980s (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 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 vertical mergers can lead to anticompetitive effects in some situations. A fundamental insight of this approach is that vertically integrated firms will have different incentives from nonintegrated ones in 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 competing aggressively in the input market, and it will thus try to do so to raise

[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 pro-competitive effect of vertical mergers can arise due to, for instance, eliminating double markup or avoiding inefficient input substitution. See Perry (1989) for a survey of the literature.

the rivals' costs. Vertical foreclosure can therefore arise in equilibrium. The paper by Salop and Scheffman (1987) forms the basis for this argument, and Ordover, Saloner, and Salop (1990, hereinafter OSS) is perhaps the best-known paper that pioneered the equilibrium approach to the analysis of vertical mergers.[3]

In this paper, I shall argue that the new theories on vertical mergers have ignored an important point, namely that vertical integration not only changes the integrated firm's incentive to supply inputs to its downstream rivals, but it may also change the *rivals'* incentives to purchase inputs from alternative suppliers. Once this is realized, an equilibrium theory of vertical mergers can be developed without some of the controversial assumptions made 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 rival may recognize that if it purchases inputs from the integrated firm, the integrated firm may have less incentive to cut prices in the downstream market, which will benefit the rival. Therefore, vertical integration can change the incentive of a downstream rival in selecting its input supplier, making it a strategic instead of a passive buyer in the input market.

I consider a model where 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) is 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 (including possibly an integrated firm) then make simultaneous price offers to supply to any remaining independent downstream firm(s), which are either accepted or re-

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

jected; and afterwards the downstream market prices are set. As it will become more clear later, this formulation follows closely the approach in OSS, but with several important differences. First, in the model here the integrated firm does not have more commitment power than an unintegrated upstream firm in setting upstream prices. This avoids a major criticism to OSS.[4] Second, I allow the possibility that one of the upstream producers is more efficient, while in OSS all upstream producers have identical constant marginal cost. Third, I allow an unintegrated downstream firm to behave strategically in choosing input suppliers, while in OSS it is implicitly assumed that it will always purchase from the supplier with the lowest price.

Our 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 integrated firm may be able to sell input to the unintegrated downstream firm at a price higher than m. To see how this occurs, suppose that the integrated firm and the independent upstream firm(s) all offer input price m to the independent downstream firm, as if they are Bertrand competitors in the input market (which would be the outcome if no vertical integration had occurred). The independent downstream firm will strictly prefer to accept the offer to purchase from the integrated firm, since the latter will then have less incentive to cut prices in the downstream market, knowing that its upstream profit will be reduced if its downstream rival decreases sales. This then enables the integrated firm to raise the input price to its downstream rival above m. On the other hand, as it turns out, when $m_1 = m$, the integrated firm will not be

[4] The foreclosure result in the OSS model has been criticized for relying on the integrated firm's additional commitment ability and otherwise the result would not be an equilibrium (Hart and Tirole, 1990; and Reiffen, 1992). In response, Ordover, Saloner, and Salop (1992) argued that vertical foreclosure can be an equilibrium without commitment in OSS if the competition in the upstream market is modeled as a certain bidding game.

able to raise the input cost of the downstream rival.

Thus, vertical merger can cause market foreclosure by raising the rival's cost. Ironically, this happens not because the integrated firm will refrain from supplying the rival, but rather because the integrated firm will continue to supply to the rival. This result may appear surprising and even counter-intuitive at first glance, but it can become easier to understand if one realizes that firms may compete less aggressively if they are also customers/suppliers to each other. The market foreclosure in our model is thus a consequence of tacit collusion by the integrated firm and its downstream rival.[5] However, such market foreclosure need not raise prices in the final market, since vertical merger can occur in equilibrium if and only if it results in an efficiency gain, which can be due to either the elimination of a double markup when a downstream firm merges with a more efficient upstream firm or the direct efficiency gain when a vertical merger reduces the marginal cost of production in the upstream industry. Therefore, vertical mergers will involve both efficiency and collusive effects, and this trade-off is a direct consequence of our result concerning when equilibrium vertical mergers occur. We find that there is a simple and familiar measure to evaluate whether a vertical merger is pro- or anticompetitive: it tends to be procompetitive when the products of the downstream firms are highly differentiated and anticompetitive when these products are close substitutes.

It is quite common for a vertically integrated firm to continue to supply 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 US Department of Justice challenged Lockheed Martin's proposed acquisition

[5] 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 non-cooporative game.

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" may lead to reduced competition (Morse, 1998). The proposed merger was eventually abandoned.[6] The point of this paper, however, goes beyond to show that such concerns may have theoretical merit, in a rather unanticipated way; it also shows that such 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 paper is organized as follows. Section 2 describers the details of our model. Section 3 solves the equilibrium of the model and establishes the main result of the paper. Section 4 studies the competitive effects of vertical mergers. Section 5 discusses alternative assumptions and robustness of our results. Section 6 concludes.

2. THE MODEL

Two (downstream) firms, $D1$ and $D2$, produce differentiated products.[7] 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, $U1$, $U2$,...,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.[8]

[6] Similar concerns have been raised in some of the other recent vertical merger cases. For instance, in 1995, FTC challenged the proposed acqusition of PCS Health Systems by Eli Lilly, alleging among other things that "as a result of Lilly's contact through PCS with other pharmaceutical companies, collusion would be facilitated." (Morse, 1998).

[7] Our results will extend to situations where there are more than two downstream firms. Considering only two downstream firms makes the analysis tractable.

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

Our analysis would not change if $U1..., Uh$ all have constant marginal cost m but a vertical merger between a firm in D and $U1$ reduces the integrated firm's marginal cost in U from m to m_1. Thus the model can be equivalently viewed as one where a vertical merger may lead to a cost reduction. To keep the exposition as concise as possible, 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 0 (thus the firms in D are symmetric).

To develop an equilibrium theory of vertical mergers, we follow OSS and consider a game with the following stages. Stage 1: downstream firms can bid to acquire $U1$. When a vertical acquisition occurs, we assume, without loss of generality, that it is conducted by $D1$ and the integrated firm is called F. Stage 2: $D2$ can counter the merger of $D1$ and $U1$, if there is one, by a merger with an unintegrated U firm, say, $U2$. Stage 3: upstream producers simultaneously make price offers to supply all the input a downstream firm will purchase, and each downstream firm either accept one of the offers or reject all of them. Thus, input prices and the identity of the supplier(s) are determined at this stage.[9] Stage 4: downstream firms simultaneously choose prices, given input prices and the identities of firms in U that would actually supply D. To avoid trivial situations, we assume that if firms are indifferent between merger or no merger, they choose no merger, as would be the case if mergers involve (e.g. legal) costs. Figure 1 illustrates the game.

(Insert Figure 1 about here.)

The major difference here from OSS is that no additional commitment power is given to F, and the identity of the supplier may matter.[10] In OSS the third stage

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

[10]In OSS, it is assumed that F is able to first commit to a price higher than m, which then enables

is actually before the counter-merger stage. But since price changes are likely to be easier to make than organizational changes, we place the counter-merger stage earlier, as is in Hart and Tirole. We incorporate the idea that the identity of suppliers may matter to a downstream firm by assuming that it chooses its supplier at stage 3, before the downstream prices are determined. This amounts to assuming that parties can use requirement contracts at stage 3. This seems a natural assumption, albeit a strong one, in the context of our model. As it will become clear shortly, it can be mutually beneficial for the vertically integrated firm and its downstream rival to establish a supplier/customer relationship before determining downstream prices, and it seems likely that they will find a way to do so. A requirement contract is a simple way to achieve this in our static model, without involving any transfer payments. We shall later discuss the robustness of our results if contracting is not allowed and only spot transaction can be conducted in the upstream market.[11]

As in OSS, we 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 our analysis, we first consider the downstream market in isolation without modeling its strategic interaction with the upstream market. Suppose that $D1$ and $D2$ have marginal costs c_1 and c_2. Their profits then are

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

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

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

$U2$ to raise the price sold to $D2$, causing market foreclosure. This assumption has been a source of much controversy.

[11] Our result concerning equilibrium vertical mergers will still be valid with this change to our model, but the efficiency effect of a vertical merger will then always dominate the collusive effect (see the discussion in Subsection 5.2).

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 equation (1). By the symmetry of the demand functions, we have $p_1(c_1, c_2) = p_2(c_1, c_2)$ and $\pi_1(c_1, c_2) = \pi_2(c_1, c_2)$ if $c_1 = c_2$.

We 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 equation (1) would be upward slopping, with the one for $i = 1$ being steeper. 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.

We shall in addition assume:

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

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, we shall 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. Then from (1), for* $i, j = 1, 2$ *and* $i \neq j$,

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

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

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

We note that for any given demand functions, both m_1 and $m - m_1$ should not be too large, so that positive output will be produced and effective competition exists in U. For our linear-demand example, we need $m_1 < 1$ and

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

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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 $m = m_1$.[12] Thus without vertical merger the equilibrium profits for $D1$, $D2$, and $U1$ are simply $\pi_1(m, m)$, $\pi_2(m, m)$, and $(m - m_1)[q_1(p_1(m, m), p_2(m, m)) + q_2(p_1(m, m), p_2(m, m))]$. Notice that this would be the same outcome if the input prices announced are spot prices and firms in D choose suppliers only after downstream prices are determined. In other words, without vertical merger, the identity of suppliers in the upstream market does not matter to a downstream firm.

The subgame that starts from the vertical merger of $D1$ and $U1$ will be solved using backward induction. We shall first characterize equilibrium in the downstream

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

market 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.

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

3.1 The Downstream Market with Vertical Merger of $D1$ and $U1$

To characterize equilibrium in the downstream market when only $D1$ and $U1$ have merged, there are two possible cases to consider, depending on from whom $D2$ purchases inputs.

(i) $D2$ agrees to buy all input from an unintegrated U firm at price w_2.

Let the lowest price offered by $U2, ...Uh$ be w_2. Then, if $D2$ buys from an unintegrated upstream firm, it will pay w_2. In this case, $c_1 = m_1$, $c_2 = w_2$, and in the downstream market the 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 $\pi_2(m_1, w_2)$. Notice that in this case $D2$ interacts with F in D but not in U.

(ii) $D2$ agrees to buy all 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 the profit of $D2$ be π_2^F. Then

$$\begin{aligned}
\pi_1^F &= (p_1 - m_1)q_1(p_1, p_2) + (w_1 - m_1)q_2(p_1, p_2), \\
\pi_2^F &= (p_2 - w_1)q_2(p_1, p_2).
\end{aligned}$$

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

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

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

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, $(w_1 - m_1)\frac{\partial q_2(p_1,p_2)}{\partial p_1}$, that is not present when $D2$ purchases from an unintegrated firm in U. Denote the equilibrium profits by $\pi_1^F(m_1,w_1)$ and $\pi_2^F(m_1,w_1)$ in this case.

Similar to (2), we have

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

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 $\frac{\partial q_2}{\partial p_1} > 0$ and prices are strategic complements, we have:

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, which 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. However, 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 $m_1 < m$.

Proposition 1 *If $w > m_1$, then $\pi_2^F(m_1,w) > \pi_2(m_1,w)$.*

Proof.

$$\begin{aligned}
\pi_2^F(m_1,w) &= (p_2^F(m_1,w) - w)q_2(p_1^F(m_1,w), p_2^F(m_1,w)) \\
&> (p_2(m_1,w) - w)q_2(p_1^F(m_1,w), p_2(m_1,w)) && \text{[by revealed preference]} \\
&> (p_2(m_1,w) - w)q_2(p_1(m_1,w), p_2(m_1,w)) && \text{[since } p_1(m_1,w) < p_1^F(m_1,w)\text{]} \\
&= \pi_2(m_1,w). \blacksquare
\end{aligned}$$

Proposition 1 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. This is the key insight behind the theory of vertical mergers in this paper*: vertical integration changes the incentive of a rival in selecting its input supplier.*

Since

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

we have:

Lemma 2 $\frac{\partial \pi_2^F(m_1,w_1)}{\partial w_1} < 0.$

We now define w_1^* to be such that

$$\pi_2^F(m_1, w_1^*) = \pi_2(m_1, m). \tag{8}$$

Then 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 $\frac{\partial \pi_2^F(m_1,w_1)}{\partial w_1} < 0$. Furthermore, $w_1^* > m$ if $m_1 < m$ and $w_1^* = m$ if $m_1 = m$. We note that the difference between 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, w_1^* will be close to m and also to m_1, and hence:

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

which says that, within a certain range, $F's$ profit is higher if $D2$ purchases input from F at a higher price. In the rest of the paper, we assume condition (9) holds.

In our linear-demand example, $w_1^* = m + \frac{1}{2}\beta^2 \frac{m-m_1}{1+2\beta}$; and condition (9) holds as long as condition (4) is satisfied.

Lemma 3 $p_1^F(m_1,m) \leq p_2^F(m_1,m) \leq p_1(m,m) = p_2(m,m)$, *where the strict inequalities hold if and only if* $m_1 < m$.

Proof. $p_1^F(m_1,m)$ and $p_2^F(m_1,m)$ satisfy:

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

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

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

Comparing these conditions with those for $p_i(m,m)$ in condition (1),

we have $p_1^F(m_1,m) < p_2^F(m_1,m) < p_1(m,m) = p_2(m,m)$. ■

Thus, if $m_1 < m$ and a vertical merger does not raise the rival's cost ($w_1 = m$), it would make the downstream market more competitive.

3.2 The Upstream Market with Vertical Merger of $D1$ and $U1$

We now study equilibrium in the upstream market when only $D1$ and $U1$ have vertically integrated. We have:

Proposition 2 *In the subgame where F is formed through the merger of $D1$ and $U1$ and no other merger has occurred, the unique equilibrium outcome is that (i) if $m > m_1$, $D2$ agrees to purchase all of its input from F at price $w_1 = w_1^* > m$; and (ii) if $m = m_1$, $D2$ will purchase input from either F or an unintegrated upstream firm at price m.*

Proof. (i) First, by construction, the strategies of F offering w_1^*, all unintegrated U firms offering $w_2^* = m$, and $D2$ agreeing to purchase from F when $\pi_2^F(m_1, w_1) \geq \pi_2(m_1, w_2)$ constitute an equilibrium of the subgame. Thus what is proposed is an equilibrium outcome, and $w_1^* > m$ since $m_1 < m$.

Next, there can be no equilibrium where $w_1 > w_1^*$. This is because if $w_1 > w_1^*$, $\pi_2^F(m_1, w_1) < \pi_2(m_1, m)$, and hence $D2$ would prefer to purchase from an unintegrated U firm at a price 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 w_1^* to sell to $D2$. Similarly, there can be no equilibrium where $w_1 < w_1^*$, since F can increase its profit by rasing w_1 to w_1^*.

Finally, there can be no equilibrium if $D2's$ behavior is such that it purchases from an unintegrated U firm when $\pi_2^F(m_1, w_1) = \pi_2(m_1, m)$. Thus other possible equilibria can differ from the proposed one only in that one or several unintegrated U firms may offer $w_2 > m$. But the equilibrium outcome is always for F to offer w_1^* and $D2$ to accept $F's$ offer.

(ii) If $m = m_1$, then $w_1^* = m$ and $\pi_2^F(m_1, m) = \pi_2(m_1, m)$. In this case, it is an equilibrium for F and unintegrated U firms to offer m and for $D2$ to accept an offer from 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 $D2$. Hence the proposed is the unique equilibrium outcome. ■

Therefore, if $m > m_1$, F will charge $D2$ an input price that is high enough to leave $D2$ just indifferent between purchasing from F at $w_1^* > m$ or from an independent upstream firm at m. But if $m = m_1$, F will not be able to sell to $D2$ at $w_1 > m$.

3.3 Will There Be Any Counter-merger if $D1$ and $U1$ 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 $\pi_2^F(m_1, w_1^*) = \pi_2(m_1, m)$, $D2$ and $U2$ cannot benefit from the merger. Therefore, in equilibrium, there will be no counter-merger if $D1$ and $U1$ merge.

3.4 Equilibrium Vertical Merger

After a vertical merger by a downstream firm with $U1$, the unintegrated downstream firm will receive $\pi_2(m_1, m)$. Competition between the downstream firms imply that $D1$ will need to pay $\pi_1^F(m_1, w_1^*) - \pi_2(m_1, m)$ in order 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:

Lemma 4 *In equilibrium, there is vertical merger by $D1$ and $U1$ if and only if*

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

We now state our main result:

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

Proof. If $m = m_1$, then

$$\begin{aligned} & \pi_1^F(m_1, w_1^*) - \left[\pi_2(m_1, m) + (m - m_1)\left(q_1(p_1(m,m), p_2(m,m)) + q_2(p_1(m,m), p_2(m,m))\right)\right] \\ = \; & \pi_1^F(m,m) - \pi_2(m,m) = \pi_1(m,m) - \pi_2(m,m) = 0. \end{aligned}$$

Hence, from Lemma 4 above, there is no vertical merger if $m = m_1$. We thus only need to show there is vertical merger if $m_1 < m$. We proceed as follows.

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

Step 2:

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

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 $p_2(m_1,m) < p_2(m,m) = p_1(m,m)$.

Step 3:

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

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:

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

Our conclusion then follows from

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

and Lemma 4. ■

4. THE COMPETITIVE EFFECTS OF VERTICAL MERGERS

Proposition 3 *A vertical merger of $D1$ with $U1$ raises the input price and reduces the market share of $D2$. It also reduces the profit of $D2$.*

Proof. First, since a merger of $D1$ and $U1$ occurs only if $m > m_1$, and since $w_1^* > m$ when $m > m_1$, the merger of $D1$ and $U1$ always raises the input price for $D2$.

Next, since $p_1^F(m_1, w_1{}^*) < p_2^F(m_1, w_1^*)$,

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

But

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

Thus the merger of $D1$ and $U1$ reduces the market share of $D2$.

Finally,

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

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

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

As in OSS and other models of vertical foreclosure, a vertical merger in our theory also raises a rival's input price and reduces its market share. In this sense there is also equilibrium vertical foreclosure. But this happens for a reason that has not been identified in the literature: vertical integration changes the rival firm's incentive to select input supplier and motivates it to purchase from the integrated firm even at prices higher than those offered by unintegrated suppliers. This in turn softens price competition in the final market and tends to make vertical integration anticompetitive. We shall call this the foreclosure or collusive effect of vertical mergers.

While it will have a collusive effect, a vertical merger in our model can occur if and only if it yields 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. 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. We shall call this the efficiency effect of vertical mergers.

One may think that, because of the collusive effect when F sells to $D2$ at $w_1 > m_1$, F should be able to sell to $D2$ at some w_1 slightly higher than m even if $m_1 = m$. To see why this is false, notice that when $D2$ purchases from F at $w_1 > m$ instead of from $U2$ at $w_2 = m$, although $D2$ benefits from $F's$ higher downstream price, it suffers from its own increased input cost. When $m_1 = m$, the direct effect of cost increase will outweigh the strategic effect of softening competition, and as a result $D2$ will not buy from F if $w_1 > m$. This can be seen most clearly from the fact that $\pi_2^F(m_1, m) = \pi_2(m_1, m)$ when $m_1 = m$ and $\pi_2^F(m_1, w_1)$ decreases in w_1.

Whether a vertical merger will be pro- or anti-competitive thus depends on the balance of its collusive and efficiency effects. Interestingly, the simple and familiar measure regarding the degree of product differentiation, $\frac{\partial q_2}{\partial p_1}$, can be used to evaluate the net effect.

Proposition 4 *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, vertical merger lowers prices in D and thus benefits consumers; and 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, vertical merger raises prices in D and thus harms consumers.*

Proof. 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 w_1^* solves $\pi_2^F(m_1, w_1^*) = \pi_2(m_1, m)$, w_1^* increases in $\frac{\partial q_2}{\partial p_1}$.

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 $\frac{\partial q_2}{\partial p_1} = 0$, we would have $w_1^* = m$ and hence, from Lemma 3 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, 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, if $\frac{\partial q_2}{\partial p_1}$ is large enough to be close to $-\frac{\partial q_1}{\partial p_1}$, then, since $w_1^* > m$ and w_1^* increases in $\frac{\partial q_2}{\partial p_1}$, 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 in this case

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

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

Thus, while vertical merger harms the integrated firm's competitor, it may or may not harm competition. When firms in the downstream market are close competitors (produce close substitutes), the collusive effect tends to dominate and the vertical merger tends to be anticompetitive; while if products are highly differentiated, the efficiency effect tends to dominate and vertical merger tends to be procompetitive.

In our linear-demand example, vertical merger lowers final prices if $\beta < 0.74827$, and it raises final prices if $\beta > 1.8414$. When $0.74827 < \beta < 1.8414$, the merger lowers the final price for product 1 but raises the final price for product 2.

The new theories of vertical foreclosure have mainly focused on the anticompetitive effects of vertical mergers. As such, they are inadequate in providing guidance for evaluating the competitive effects of vertical mergers. Recently, Riordan (1998) has developed an interesting model where 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. Our results here provide clear policy implications for vertical mergers when the downstream market is oligopoly.[13]

5. DISCUSSION

We now consider several possible changes to the model to gain insights on the robustness of our results.

5.1 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

[13] Riordan also finds that vertical integration by a dominant firm may or may not reduce social welfare. Our analysis has focused on the competitive effects of vertical mergers. It appears also true here that a vertical merger may raise or lower welfare, but a detailed analysis is beyond the scope of this paper.

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; and, when $D1$ and $U1$ have vertically integrated, the profits of F and $D2$ are

$$\begin{aligned}\pi_1^F &= q_1\left[P(q_1+q_2)-m_1\right]+(w_1-m_1)q_2,\\ \pi_2^F &= q_2\left[P(q_1+q_2)-w_1\right].\end{aligned}$$

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

$$\begin{aligned}\frac{\partial \pi_1^F}{\partial q_1} &= P(q_1^F+q_2^F)-m_1+q_1^F\frac{\partial P(q_1^F+q_2^F)}{\partial q_1}=0,\\ \frac{\partial \pi_2^F}{\partial q_2} &= P(q_1^F+,q_2^F)-w_1+q_2^F\frac{\partial P(q_1^F+q_2^F)}{\partial q_2}=0.\end{aligned}$$

But these are the same equilibrium conditions if $D2$ purchases from an unintegrated upstream firm at $w_2 = w_1$. Therefore it is optimal for $D2$ to purchase the input at the lowest price regardless of the identity of the supplier, 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 $m_1 < m$. Therefore,

$$\begin{aligned}&\pi_1^F(m_1,m)=q_1^F(m_1,m)\Big(P(q_1^F(m_1,m)+q_2^F(m_1,m))-m_1\Big)+(m-m_1)q_2^F(m_1,m)\\ =\;& q_1^F(m_1,m)\Big(P(q_1^F(m_1,m)+q_2^F(m_1,m))-m\Big)+(m-m_1)\Big[q_1^F(m_1,m)+q_2^F(m_1,m)\Big]\\ \geq\;& q_2^F(m_1,m)\Big(P(q_1^F(m_1,m)+q_2^F(m_1,m))-m\Big)+(m-m_1)\left[q_1(m,m)+q_2(m,m)\right]\\ =\;& \pi_2^F(m_1,m)+(m-m_1)\left[q_1(m,m)+q_2(m,m)\right],\end{aligned}$$

where the inequality holds strictly if and only if $m_1 < m$. Thus, from Lemma 4, there is vertical merger if and only if $m_1 < m$. Furthermore, if $m_1 < m$,

$$\pi_2^F(m_1,m) = q_2^F(m_1,m)\Big(P(q_1^F(m_1,m)+q_2^F(m_1,m))-m\Big)$$

$$< \quad q_2(m,m)\left(P(q_1(m,m)+q_2(m,m))-m\right)=\pi_2(m,m).$$

We therefore have:

Remark 1 *If our 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. However, if one believes that an integrated firm would 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. I shall spare the readers from the details of this case, but the intuition is fairly straightforward. When $D2$ purchases the input from F who is a Stackelberg leader in D, F will be less aggressive in setting its output in D because it realizes that its higher output would reduce $D2's$ output and hence $D2's$ purchase of input. This would then motivate $D2$ to choose F as its supplier even if $F's$ price is slightly higher than those of unintegrated suppliers, provided $m_1 < m$.

Therefore, the main result of our analysis, that vertical mergers occur in equilibrium if and only if there is an efficiency gain, holds under quantity competition as well. It also becomes clear that whether a vertical merger will lead to higher costs for rivals and 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 explains why a vertical merger has a collusive effect under Bertrand or Stackelberg competition, but not in the Cournot model.

5.2 No Contracting or No Discrimination in the Upstream market

An important assumption of our model is that a downstream firm, before setting its output price, can contract with an upstream supplier to purchase all required input at the contract price. It would thus be interesting to know what happens to our result if such contracting is not possible and only spot transaction in the upstream market is allowed. Suppose that at Stage 3, any upstream producer (including possibly F) can only announce the prices it will supply any independent downstream firm, but they cannot enter into any agreement specifying who would supply a downstream firm. That is, the downstream firm(s) decide from whom to purchase input only after the downstream prices are set. Then in equilibrium F will set $w_1 = m$ in order to sell to $D2$, and $D2$ must indeed purchase from F if $m_1 < m$.[14] From our proof of Theorem 1,

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

if $m_1 < m$. From Lemma 3, $\pi_1^F(m_1, m) = \pi_1(m_1, m) = \pi_2(m_1, m)$ if $m_1 = m$. This together with Lemma 4 implies that there is vertical merger in equilibrium if and only if $m_1 < m$. That is, Theorem 1 continues to hold in this case. However, since $p_1^F(m_1, m) < p_2^F(m_1, m) < p_1(m, m) = p_2(m, m)$ if $m_1 < m$ from Lemma 3, in this case the vertical merger always benefits consumers.

Another possible change to our model, which has the same effect to our analysis as allowing no contracting in the upstream market, is to assume that no discrimination

[14] Since the downstream prices are already set, $D2$ will simply purchase input from the seller with the lower price. $D2$ 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 $m_1 < m$.

is allowed in the upstream market. Suppose that a downstream firm is required by law to purchase input from any supplier with the lowest price.[15] Then in equilibrium F will also set $w_1 = m$ in order to sell to $D2$, and $D2$ will indeed purchase from F if $m_1 < m$. Therefore, the results concerning equilibrium vertical mergers and their competitive effects in this case will be the same as those when no contracting is allowed. We therefore have:

Remark 2 *If only spot transaction is allowed in the upstream market, or if firms in D are required by law to purchase from lowest price supplier, then Theorem 1 continues to hold; i..e., there is vertical merger in equilibrium if and only if $m_1 < m$. However, in this case the efficiency effect of vertical mergers dominates the collusive effect and vertical mergers benefit 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.

Therefore, even if no contracting or no discrimination is allowed in the upstream market, the main result of our analysis is still valid, to the extent described in Remark 2. However, when requirement contracts can be used and downstream firms do not have to purchase from the lowest price supplier, a vertical merger can raise the rival's cost and be anticompetitive. Notice that vertical merger still plays a key role in causing the anticompetitive effects, since without it the same type of requirement

[15] One may wonder whether such legal requirement is enforcable, considering that contracted prices may not be observable and in real situations the inputs provided by different producers may not be identical.

contracts or allowing discrimination in the upstream market would have no impact on equilibrium prices in both the upstream and downstream markets.

5.3 Allowing Other Contract Forms

We now change the model to consider alternative contract forms that can be used at stage 3. We shall consider two-part tariff contracts that may or may not be requirement contracts.

If parties can enter into a two-part tariff requirement contract that allows transfer payments from the seller to the buyer, then it is possible that $U1$ could reach collusive outcome with $D1$ and $D2$ by making a transfer payment to them and in exchange require them to purchase input from it at some optimally chosen price $w > m$. This may then maximize the joint profits of upstream and downstream industries. In this case, there would be no need for vertical integration. However, such a contract is essentially for an upstream firm to use an explicit transfer payment to "bribe" a downstream firm to purchase from it at an inflated price, and it seems questionable whether such contracts are feasible in practice.

If parties can enter into a two-part tariff requirement contract, but the upstream firm (the seller) cannot make explicit transfer payments to the downstream firm (the buyer), then we have the usual form of two-part tariff contracts, where the buyer pays a fixed fee, $T \geq 0$, together with a unit price w, except that here there is also the additional agreement that the buyer will purchase all input from the seller. In this case, in equilibrium we will have $T = 0$, and all the results of our model will remain the same. This is because if (w', T') is an equilibrium contract between a firm producing in U and a firm in D, where $T' > 0$, the joint profits of the contracting parties can be increased without making either party worse off if T is reduced to zero with a proper increase in w.

If the contracts available are two-part tariff contracts, without required purchases, then the equilibrium outcome will be the same as if the upstream market is a spot market with linear price and the downstream firms choose suppliers after the downstream prices are set ($T = 0$ in this case). The analysis in Section 5.2 then applies, and our main result holds to the extent described in Remark 2.

To summarize, we have:

Remark 3 *Assume that any input supplier is not allowed to make explicit transfer payments to its customer(s). Then, our analysis is not changed by the use of two-part tariff contracts: when the two-part tariff contracts can also be requirement contracts, all results of our model will hold; and when the two-part tariff contracts are not allowed to be requirement contracts, our results will be the same as those stated in Remark 2.*

5.4 Comparing to Horizontal Mergers

There are obvious similarities between our model of vertical mergers and models of horizontal mergers. Our 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 papers, however, depend on there being Cournot competition, and as Davidson and Deneckere (1985) has shown, with Bertrand competition no efficiency gain is needed to cause a horizontal merger. The result in our model is stronger in the sense that it holds for both Bertrand and Cournot competition.

Our 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 somewhat similar trade-offs 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. 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 FTC).

6. CONCLUSION

The new theories of vertical mergers have offered the important insight that vertical integration changes an upstream producer's incentive to supply the integrated firm's downstream rivals. This paper suggests that vertical integration also changes the rivals' incentive to choose input suppliers. With this new insight, we have developed an equilibrium theory of vertical mergers, incorporating the strategic behaviors in the upstream market of both the integrated firm and its downstream rivals. Our 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. We also find that there is a simple and familiar measure, namely the degree of production differentiation in the downstream market, that can be used to evaluate whether a vertical merger is likely to benefit or harm consumers.

In our theory, a vertical merger can raise downstream rivals' cost, not because the rivals are excluded from input suppliers, but because the merger changes 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.[16] However, this collusive effect can be realized if and

[16]The idea that multimarket contacts may facilitate collusion has long been known in economics, and has been formally modeled in Bernheim and Whinston (1990) in the context of repeated inter-

only if the vertical merger also has an efficiency effect that occurs due to lowered marginal cost of the integrated firm in producing the final product. It is generally believed in the literature 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). Our 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 (1975) and Gal-Or (1999). Our focus on horizontal competition and vertical merger is complementary to these alternative approaches. The idea that vertical integration changes both the integrated firm and its rivals' strategic incentives may have broader implications than for the theory of vertical mergers developed in this paper. It may also help us understand more generally how horizontal competition affects and is affected by the vertical organization of industries. This remains an interesting area for future research.

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actions. Our analysis suggests that this idea can also be important in a vertical context, without the need of repeated interactions, and can help understand vertical mergers.

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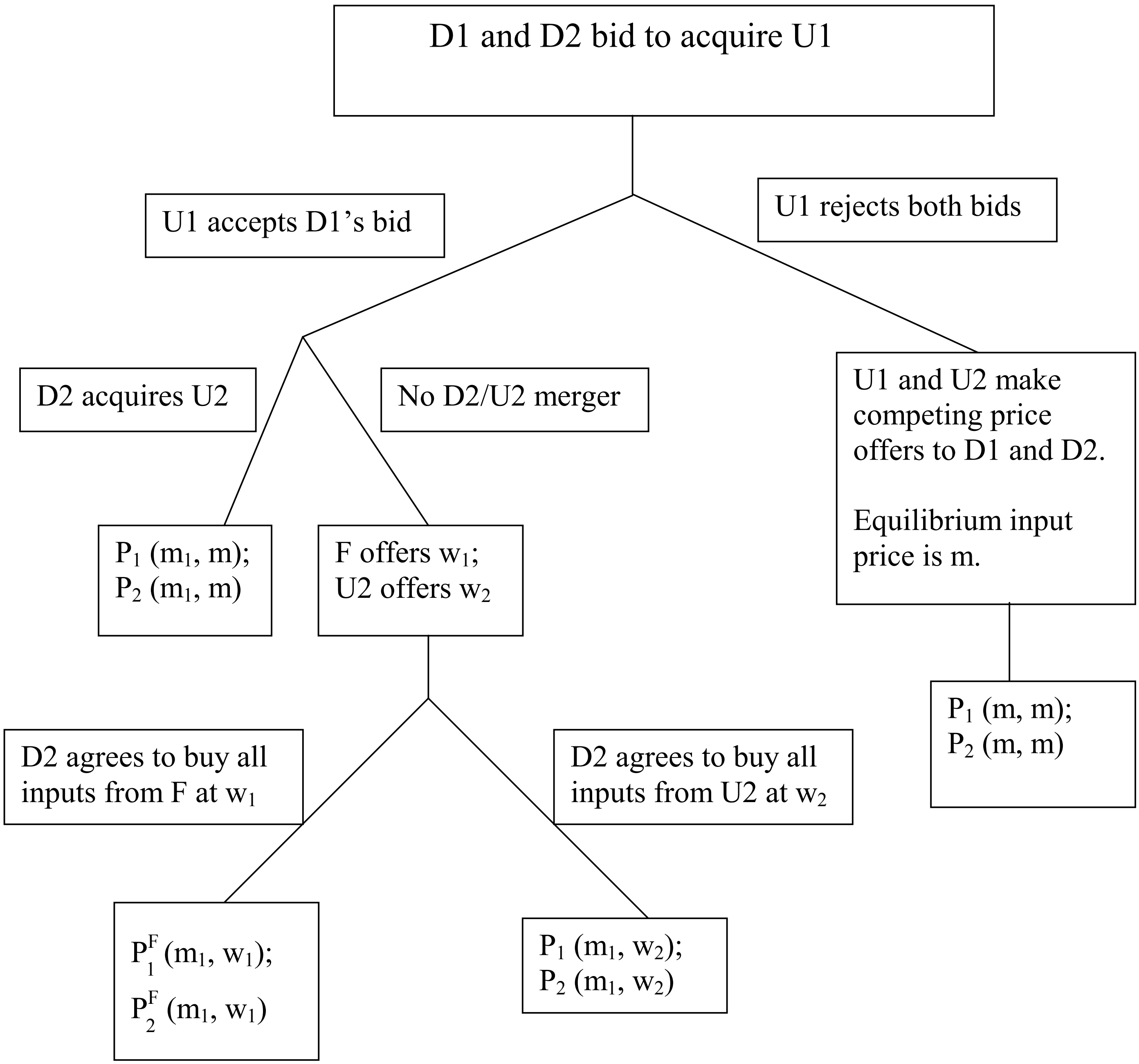
D1 and D2 bid to acquire U1
U1 accepts D1's bid
U1 rejects both bids
D2 acquires U2
No D2/U2 merger
U1 and U2 make competing price offers to D1 and D2.
Equilibrium input price is m.
P_1 (m_1, m); P_2 (m_1, m)
F offers w_1; U2 offers w_2
P_1 (m, m); P_2 (m, m)
D2 agrees to buy all inputs from F at w_1
D2 agrees to buy all inputs from U2 at w_2
P_1^F (m_1, w_1); P_2^F (m_1, w_1)
P_1 (m_1, w_2); P_2 (m_1, w_2)

Figure 1