Vertical integration and upstream horizontal mergers

Ioannis N. Pinopoulos*

Department of Economics, University of Macedonia,
156 Egnatia Street, Thessaloniki, Greece,
E-mail address: me0710@uom.gr

Abstract

We study upstream horizontal mergers when one of the merging parties is a vertically integrated firm. We assume that all of the vertically integrated firm’s upstream production is directed to its downstream affiliate (captive sales). We demonstrate that such type of mergers harm consumers through a vertical partial foreclosure effect even though they do not affect concentration in the upstream merchant market. Moreover, taking into account upstream cost asymmetries, we show that consumer surplus may increase due to the merger even though input prices increase.

Keywords: Vertical relations; vertical integration; horizontal mergers; consumer surplus

JEL Classification Codes: L11; L13; L41; L42

*I am much indebted to Christos Constantatos and Chrysovalantou Milliou for their valuable comments and suggestions. Financial support from the Greek State Scholarships Foundation (I.K.Y.) is also gratefully acknowledged. I am fully responsible for any errors or omissions.
1. Introduction

A classic topic of antitrust economics is the welfare effects of horizontal mergers – that is mergers between competitors. Since vertical relations are ubiquitous in real-world markets, it is nowadays widely acknowledged, by both economic theorists and antitrust agencies, that the vast majority of horizontal mergers take place in either the upstream or the downstream sector of vertically related industries.

In this paper we study upstream horizontal mergers. A key aspect of our analysis is that one of the merging parties is a vertically integrated firm. In other words, one insider party to the upstream merger is also present in the downstream market through a subsidiary. This assumption is primarily motivated by one of the largest oil mergers ever, namely the BP/ARCO merger. In 1999, British Petroleum Amoco (BP) announced its intention to acquire the Atlantic Richfield Company (ARCO). Whereas both BP and ARCO were present in the Alaskan North Slope (ANS) – the upstream market for crude oil –, only ARCO was present downstream in West Coast refining and marketing. Moreover, BP was a major supplier of crude oil to ARCO’s competitors, such as Chevron and Tosco.

As Bulow & Shapiro (2002) comment, the basic downstream antitrust concern in the BP/ARCO merger “was whether the acquisition of ARCO would allow BP to elevate the price of ANS crude oil to West Coast refineries. Ultimately, higher ANS crude oil prices might lead to higher prices of refined products, especially gasoline, on the West Coast.” The objective of this paper is to provide a formal explanation of the aforementioned antitrust issue. Moreover, we try to address the following questions of related interest: Are there any conditions under which the merger decreases input prices and increases consumer surplus? More importantly, are there any conditions under which the merger increases consumer surplus even though it increases input prices?

We initially consider a two-tier market consisting of two competing vertical chains. In each chain, there is a single upstream firm that produces an input which a single downstream firm uses in one-to-one proportion in the production of a differentiated final good. We assume that one vertical chain is vertically integrated whereas the other chain is vertically separated. At some point, the vertically integrated chain considers merging with the upstream independent input supplier. Such a merger is classified as horizontal, since both merging entities are present in the upstream market, it has nevertheless important vertical

1See Bulow & Shapiro (2002) for a very thorough discussion of the BP/ARCO merger.
implications, since the independent downstream firm must now purchase its input from the upstream counterpart of its rival in the downstream market.

We show that under upstream cost symmetry, the aforementioned horizontal merger raises the input price, inducing therefore a less aggressive behavior of the independent downstream firm, which yields market share to its integrated rival. This translates the higher input price into higher final-good prices and lower total output, making consumers worse off. Since in the pre-merger case all of the vertically integrated firm’s upstream production is directed to its downstream affiliate (captive sales) the merger does not affect concentration in the upstream merchant market, which is monopolized in both, the pre- and the post-merger situation. Therefore, the negative impact on consumer surplus stems entirely from the merger’s vertical partial foreclosure effect.²

It is well-known that upstream cost differences are important and prevalent in natural resource industries. For instance, in the oil and gas industry, the costs of extracting crude oil differ significantly between producers (Gaudet et al., 1999). Taking into account upstream cost asymmetry, we assume that, in the post-merger case, the more efficient firm transfers its technology to the less efficient firm.³ When the independent upstream firm is less efficient than the upstream division of the vertically integrated firm, the merger creates efficiency gains in the upstream production that is directed to the independent downstream rival causing the input price to fall. This effect works against the aforementioned vertical foreclosure effect and when it is sufficiently large it may outweigh the latter, resulting in lower input and final-good prices, thus benefiting consumers.

When the independent upstream firm is more efficient than the upstream division of the vertically integrated firm, on the one hand, the merger does not lower the cost of the upstream production directed to the independent downstream firm, leaving at play only the vertical foreclosure effect. Hence, as in the case of upstream cost symmetry, the input price always increases pulling with it the final-goods prices. On the other hand, the merger also creates efficiency gains in the upstream production directed to the downstream division of the merged firm, thus tending to decrease both final-good prices. As it turns out, the final-good price of the independent downstream firm always increase due to the merger irrespective of

²Vertical foreclosure is partial in the sense that the independent downstream firm pays a higher input price and produces less of the final good in the post-merger case, however, it is not driven out of the market (in which case foreclosure is complete or full).
³Assuming that the post-merger entity inherits the lowest cost of the merging parties is problematic when the pre-merger marginal cost differences are due to site-related extraction costs. Nevertheless, to the extent that marginal cost differences are also due to factors other than site-specific ones - for instance due to differences in the extracting method - this assumption works as fair simplification of the situation.
the magnitude of the efficiency gains. However, when the efficiency gains are sufficiently large, the final-good price of the vertically integrated firm decreases and consumer surplus increases as a result of the merger.\footnote{It is also shown that the decrease in the final-good price of the vertically integrated firm is a necessary (but not sufficient) condition for consumer surplus to increase.}

There is a large literature on the effects of upstream mergers in vertically related markets. This literature, which begins with the seminal work of Horn & Wolinsky (1988), also includes, among others, Ziss (1995), Inderst & Wey (2003), O'Brien & Shaffer (2005), Milliou & Petrakis (2007) and Milliou & Pavlou (2013). A key feature of the aforementioned studies is that upstream mergers take place in vertically separated industries. To the best of our knowledge, the case where one of the merging parties is vertically integrated has not been formally examined by the existing literature.

The rest of the paper is organized as follows. In Section 2, we describe the baseline model under upstream cost symmetry. In Section 3, we perform the equilibrium analysis and derive our main results. In Section 4, we modify the baseline model by introducing upstream cost asymmetry. Section 5 concludes.

2. The baseline model with upstream symmetric costs

We consider a vertically related market initially consisting of two competing vertical chains. In each chain $i = 1, 2$ there is a single upstream firm, $U_i$, that produces an input which a single downstream firm, $D_i$, uses in one-to-one proportion in the production of a differentiated final good. We assume that chain 1 is vertically integrated, whereas chain 2 is vertically separated, i.e., there is the vertically integrated firm $U_1-D_1$, one independent upstream supplier $U_2$ and one independent downstream firm $D_2$.

Marginal production costs in the upstream market are denoted by $c_{U_i}$. We assume at this point that $c_{U_1} = c_{U_2} = c_U$, so the upstream division of the integrated firm and the independent upstream supplier are equally efficient as input providers. Marginal transformation costs in the downstream market are denoted by $c_{D_i}$. No further assumptions are made regarding the relationship between $c_{D_1}$ and $c_{D_2}$.

We then consider the case where the independent upstream supplier $U_2$ and the vertically integrated firm $U_1-D_1$ contemplate merging to form a new entity, denoted as firm $I$. Such
merger is qualified as horizontal since both firms are present in the upstream market, it has, nevertheless, an important vertical aspect in that U2 is the input supplier of U1-D1’s rival in the downstream market. Our assumption, hitherto, of upstream symmetric costs implies that the merger does not generate efficiency gains, thus allowing to focus on the implications of the vertical relationship.

Suppose that \( U(q_1,q_2) \) is a differentially strictly concave utility function and let \( q = (q_1,q_2) \). The representative consumer maximizes \( U(q) - pq \) giving rise to an inverse demand system \( p_i = p(q_i,q_j), \ i,j = 1,2, i \neq j \), which is twice continuously differentiable. Inverse demands will be downward sloping, \( \partial p_i / \partial q_i < 0 \), and symmetric cross effects will be negative, \( \partial p_i / \partial q_j = \partial p_j / \partial q_i < 0 \), implying that final-goods are substitutes. We also assume that the own effect is larger than the cross effect, that is \( \left| \partial p_i / \partial q_i \right| > \left| \partial p_i / \partial q_j \right| \).

We model market interactions as a three-stage game with timing as follows. In the first stage, firms U1-D1 and U2 decide whether to merge or not. In the second stage, the independent supplier U2 (if the merger does not occur) or firm I (if the merger occurs) makes D2 a take-it-or-leave-it, two-part tariff contract offer; the contract consists of an input price \( w \) and a fixed fee \( F \). In the last stage, downstream competition takes place a la Cournot. Hereafter, the superscript \( S \) or \( M \) on a variable denotes the pre- or the post-merger case, respectively.

### 3. Equilibrium outcomes in the baseline model

#### 3.1. The pre-merger case

Working backwards, we start by solving the last stage of the game. Firms U1-D1 and D2 choose simultaneously and independently their final-good outputs to maximize profits:

\[
\max_{q_1} \pi_{U1-D1} = p_1(q_1,q_2)q_1 - (c_{d1} + c_U)q_1, \quad \max_{q_2} \pi_{D2} = p_2(q_1,q_2)q_2 - (w + c_{d2})q_2 - F.
\]

The first order conditions of the above maximization problems are given by,

\[
p_1 + q_1 \frac{\partial p_1}{\partial q_1} = c_{d1} + c_U,
\]

5
and

\[ p_1 + q_2 \frac{\partial p_2}{\partial q_2} = c_{D_2} + w, \]  

respectively. We make the following three assumptions:

**Assumption 1.** \( \frac{\partial^2 \pi_{U1-D1}}{\partial q_1^2} < 0 \) and \( \frac{\partial^2 \pi_{D_2}}{\partial q_2^2} < 0 \).

**Assumption 2.** \( \frac{\partial^2 \pi_{U1-D1}}{\partial q_1 \partial q_2} < 0 \) and \( \frac{\partial^2 \pi_{D_2}}{\partial q_2 \partial q_1} < 0 \).

**Assumption 3.** \( \frac{\partial^2 \pi_{U1-D1}}{\partial q_1^2} + \frac{\partial^2 \pi_{U1-D1}}{\partial q_1 \partial q_2} < 0 \) and \( \frac{\partial^2 \pi_{D_2}}{\partial q_2^2} + \left| \frac{\partial^2 \pi_{D_2}}{\partial q_2 \partial q_1} \right| < 0 \).

Assumption 1 guarantees that the second order conditions of the above maximization problems are satisfied. Assumption 2 implies strategic substitutability: firms’ best-response functions in the downstream market are downward sloping, i.e., \( dq_1/dq_2 < 0 \). Assumption 3 implies that the best-response functions are well-behaved and have slope less than one, \( |dq_1/dq_2| < 1 \), and therefore there exist unique and stable Cournot equilibria.

Solving together (1) and (2), we obtain the last-stage subgame equilibrium final-good outputs and prices as functions of the input price: \( \hat{q}_1(w), \hat{q}_2(w), \hat{p}_1(w) = p_1[\hat{q}_1(w), \hat{q}_2(w)] \) and \( \hat{p}_2(w) = p_2[\hat{q}_1(w), \hat{q}_2(w)] \). As shown in Appendix A, these last-stage subgame equilibrium outcomes have the following properties:

\[ \frac{d\hat{q}_1(w)}{dw} > 0, \quad \frac{d\hat{q}_2(w)}{dw} < 0, \quad \frac{d\hat{Q}(w)}{dw} < 0, \quad \frac{d\hat{p}_1(w)}{dw} > 0, \quad \frac{d\hat{p}_2(w)}{dw} > 0. \]  

Next, we solve the second stage of the game in order to determine the equilibrium contract terms. The independent upstream firm \( U_2 \) uses the fixed fee to fully extract \( D_2 \)’s profits,
\[ F = (\hat{p}_2(w) - w - c_{d2})\hat{q}_2(w), \]  

and thus sets the input price so as to maximize,

\[ \max_w \pi_{U2} = (w - c_u)\hat{q}_2(w) + F = (\hat{p}_2(w) - c_u - c_{d2})\hat{q}_2(w). \]  

It can be seen from (5) that the input price is chosen as if it were to maximize the unintegrated vertical chain’s profits. The first order condition of the above maximization problem, after using (2), is given by:

\[ (w - c_u) \frac{d\hat{q}_2}{dw} + \hat{q}_2 \frac{\partial \hat{p}_2}{\partial q_i} \frac{d\hat{q}_i}{dw} = 0. \]  

We know from (3) that \( \frac{d\hat{q}_2}{dw} < 0 \) and \( \frac{d\hat{q}_i}{dw} > 0 \). Therefore, given that \( \frac{\partial \hat{p}_2}{\partial q_i} < 0 \), it is straightforward that \( (w^* - c_u) \) must be negative in order for (6) to be satisfied.

**Lemma 1.** In the pre-merger case, the equilibrium input price is always lower than the upstream marginal cost, i.e., \( w^* < c_u \).

According to Lemma 1, the input price reflects a subsidy from \( U_2 \) to its respective downstream firm \( D_2 \). This finding, as well as its intuition, is in line with Milliou & Petrakis (2007), who consider the case where both vertical chains are separated. The separated vertical chain, via a lower input price, can commit to a more aggressive behavior in the final-good market. The best-response curve of its downstream firm shifts out, resulting - since best-response curves are downward sloping - in lower final-good quantity for the rival integrated chain, and higher quantity and gross profits for the own downstream firm. The portion of these gross profits that is transferred upstream via the fixed fee, more than compensates the upstream firm for the subsidy it offers.

Before proceeding to the post-merger case, we should stress here that the finding in Lemma 1 remains robust under upstream cost asymmetry: the equilibrium input price will always be lower than \( c_{U_2} \) regardless of how the latter compares to \( c_{U_1} \).

3.2. The post-merger case
When the merger occurs, firms $I$ and $D2$ choose simultaneously and independently their final-good outputs to maximize profits:

$$\max_{q_1} \pi_I = (p_1(q_1, q_2) - c_{D1} - c_U)q_1 + (w - c_U)q_2 + F,$$

$$\max_{q_2} \pi_{D2} = p_2(q_1, q_2)q_2 - (w + c_{D2})q_2 - F.$$

It is straightforward that the profit maximization problem of $D2$ is unaffected by the merger. The newly merged firm $I$ has now profits from two sources: the term $(p_1(q_1, q_2) - c_{D1} - c_U)q_1$ captures, as in the pre-merger case, profits from sales of the final good, whereas the term $(w - c_U)q_2 + F$ reflects profits from selling the input to the independent downstream rival $D2$. Since downstream competition is over quantities, however, firm $I$ cannot affect its sales of the input upstream by increasing sales of its downstream rival and thus its profit maximization problem in the downstream market also remains unaffected by the merger. Therefore, the last-stage subgame equilibrium final-good outputs and prices are the same as in the pre-merger case.

Next, we solve the second stage of the game, i.e., we determine the equilibrium contract terms. The newly merged firm $I$ uses the fixed fee to fully extract $D2$’s profits and thus set the input price so as to maximize,

$$\max_w (\hat{p}_1(w) - c_{D1} - c_U)\hat{q}_1(w) + (\hat{p}_2(w) - c_{D2} - c_U)\hat{q}_2(w)$$

(7)

Hence, the input price is actually chosen so as to maximize overall industry profits. The first order condition, after using (1) and (2), is given by:

$$\hat{q}_1 \frac{\partial p_1}{\partial q_2} \frac{d\hat{q}_2}{dw} + (w - c_U) \frac{d\hat{q}_2}{dw} + \hat{q}_2 \frac{\partial p_2}{\partial q_1} \frac{d\hat{q}_1}{dw} = 0$$

(8)

Compared to (6), expression (8) contains the additional term,
\[ \frac{\partial\hat{p}_1}{\partial q_2} \frac{d\hat{q}_2}{dw} > 0, \]

with the positive sign stemming from the fact that \( \frac{\partial \hat{p}_1}{\partial q_2} < 0 \) and \( \frac{d\hat{q}_2}{dw} < 0 \). Any increase in the input price will decrease sales of \( D_2 \) which will in turn increase the final-good price and the merged firm’s profits from downstream operations. Clearly, the independent upstream firm \( U_2 \) cannot internalize this positive effect and thus the input price will increase as a result of the merger. Unlike the pre-merger case, under a general inverse demand function we cannot determine whether the equilibrium input price will be lower (a subsidy to \( D_2 \)) or higher than upstream marginal cost. What we can determine, however, is that even if \( D_2 \) still receives a subsidy post-merger, the amount of that subsidy is lower than the corresponding amount under the pre-merger case.

The effect of the merger on consumer surplus is then clear-cut. Since the equilibrium input price increases as a result of the merger, we know from (3) that both final-good prices will increase and total output will be reduced, causing a consumer surplus reduction.

**Proposition 1.** Under upstream cost symmetry, a horizontal merger between the vertically integrated firm and the independent upstream supplier always (i) increases the input price and final-good prices and (ii) decreases consumer surplus.

Proposition 1 provides support of the basic downstream antitrust concern about such mergers: a merger between the vertically integrated firm and the independent upstream supplier increases the input price and forces the independent downstream firm to adopt a less aggressive behavior, with obvious consequences for prices and consumer surplus. Note at this point that, since in the pre-merger situation the integrated firm directs all its production to its subsidiary, the open (merchant) input-market is a monopoly in the pre-merger situation and remains so after the merger. Hence the merger has no impact on the input-market concentration and all its consequences on prices and consumer surplus derive solely from its vertical (partial) foreclosure effect. It is straightforward that the latter effect is more pronounced the less differentiated final goods are.

Finally, we solve the first stage of the game by showing that the merger is always beneficial for the merging parties and the industry as a whole. Note that
\[
\pi^k_{\text{ind}}(w^k) = (\hat{p}_1(w^k) - c_{D1} - c_U)\hat{q}_1(w^k) + (\hat{p}_2(w^k) - c_{D2} - c_U)\hat{q}_2(w^k)
\]

with \( k = S, M \),

and recall that in the pre-merger case the input price is chosen so as to maximize the un-integrated vertical chain’s profits, \( (\hat{p}_1(w) - c_{D1} - c_U)\hat{q}_1(w) \), rather than total industry profits. In the post-merger case, however, the input price is chosen so as to maximize overall industry profits, \( (\hat{p}_1(w) - c_{D1} - c_U)\hat{q}_1(w) + (\hat{p}_2(w) - c_{D2} - c_U)\hat{q}_2(w) \). Therefore, it must hold that \( \pi^{M*}_{\text{ind}}(w^{M*}) > \pi^{S*}_{\text{ind}}(w^{S*}) \). Since overall industry profits increase as a result of the merger, and \( D2 \)'s net profits remain unaffected (in both cases are equal to zero), it must hold that the combined net profits of \( U1-D1 \) and \( U2 \) increase, implying that the merger is beneficial for the merging parties.

Before closing the section, it should be noted that all the results in this section, as well as those in the following one where we introduce upstream cost asymmetry, extend straightforwardly to the situation where the firm \( U2 \) (in the pre-merger case) or firm \( I \) (in the post-merger case) engage in Nash bargaining with \( D2 \). As is well known, under two-part tariff contracts, the Nash bargaining solution can be found in two steps. First, the bargaining pair chooses the input price in order to maximize its joint surplus, which implies that the equilibrium input prices in the pre- and post-merger situation are still given by (6) and (8), respectively. Second, firms negotiate the fixed fees in order to divide their maximized joint surplus. While bargaining implies different equilibrium fixed fees with the independent downstream firm no longer making zero net profits, fixed fees are simply a device used to transfer surplus and have no impact on marginal costs or quantities produced. Hence, the merger’s effect on final-good prices, quantities and consumer surplus remains under bargaining the same as under a take-it-or-leave-it offer.

4. The modified model with upstream cost asymmetry

We now modify our baseline model by introducing upstream cost asymmetry. We consider two cases: the independent upstream firm is less efficient than the upstream division of the vertically integrated firm and vice versa. We assume that, in the post-merger case, the more efficient firm transfers its technology to the less efficient firm: the newly merged firm operates with marginal costs \( \hat{c}_U = \min \{ c_{U1}, c_{U2} \} \). When \( \hat{c}_U = c_{U1} < c_{U2} \), the merger creates efficiency gains in the upstream production that is directed to the independent downstream
rival, whereas \( c_{U1} > c_{U2} = \hat{c}_u \) implies efficiency gains in the upstream production directed to the downstream division of the merged firm.

For tractability reasons, we restrict attention to the following set of linear (inverse) demand functions (Singh & Vives, 1984),

\[
p_i = 1 - q_i - \theta q_j, \quad i, j = 1, 2, \quad i \neq j, \quad 0 < \theta < 1, \tag{9}
\]

where the parameter \( \theta \) indexes the degree of product substitutability. The higher is \( \theta \), the closer substitutes final goods are. We also assume that \( c_{d1} = c_{d2} = 0 \), which, besides simplifying calculations, allows to focus on the effects of the merger on input prices and consumer surplus stemming solely from upstream cost differences. All proofs in this section are relegated to Appendix B.

4.1. The pre-merger case.

Firms \( U1-D1 \) and \( D2 \) choose simultaneously and independently their final-good outputs to maximize profits:

\[
\max_{q_1} \pi_{U1-D1} = (1 - q_1 - \theta q_2 - c_{U1})q_1, \quad \max_{q_2} \pi_{D2} = (1 - q_2 - \theta q_1 - w)q_2 - F. \tag{10}
\]

The first order conditions give rise to the following best-response functions:

\[
q_1(q_2, c_{U1}) = \frac{1 - c_{U1} - \theta q_2}{2}, \quad q_2(q_1, w) = \frac{1 - w - \theta q_1}{2}, \tag{11}
\]

which are the equivalent of (1) and (2) under the demand function specified in (9). Solving the system of best-response functions in (11), we obtain the last-stage subgame equilibrium outcomes as functions of \( w \) and \( c_{U1} \):
\[ q_1(w, c_{U1}) = \frac{(2-\theta) + \theta w - 2c_{U1}}{4-\theta^2}, \quad q_2(w, c_{U1}) = \frac{(2-\theta) + \theta c_{U1} - 2w}{4-\theta^2}, \]

\[ Q(w, c_{U1}) = q_1(w, c_{U1}) + q_2(w, c_{U1}) = \frac{2 - w - c_{U1}}{2 + \theta}, \quad (12) \]

\[ p_1(w, c_{U1}) = \frac{(2-\theta) + \theta w + (2-\theta^2)c_{U1}}{4-\theta^2}, \quad p_2(w, c_{U1}) = \frac{(2-\theta) + \theta c_{U1} + (2-\theta^2)w}{4-\theta^2}. \]

It can be easily checked that the above last-stage subgame equilibrium outcomes satisfy the properties described in (3).

The independent upstream firm \( U_2 \) uses the fixed fee to fully extract \( D_2 \)'s profits,

\[ F = [p_2(w, c_{U1}) - w]q_2(w, c_{U1}), \quad (13) \]

and thus sets the input price to maximize:

\[ \max_w \pi_{U2} = (w - c_{U2})q_2(w, c_{U1}) + F = [p_2(w, c_{U1}) - c_{U2}]q_2(w, c_{U1}). \quad (14) \]

From the first order condition of (14), we obtain the equilibrium input price:

\[ w^{*}(c_{U1}, c_{U2}) = \frac{(2-\theta)\theta^2 - c_{U1}\theta^3 + 2(4-\theta^2)c_{U2}}{4(2-\theta^2)} < c_{U2}, \quad (15) \]

which implies a subsidy from the independent upstream supplier to the independent downstream firm, in the spirit of Lemma 1.

4.2. The post-merger case

Firms \( I \) and \( D_2 \) choose simultaneously and independently their final-good outputs to maximize profits:
max $\pi_i = (1 - q_1 - \theta q_2 - \hat{c}_U)q_i + (w - \hat{c}_U)q_2 + F,$

max $\pi_{D2} = (1 - q_2 - \theta q_1 - w)q_2 - F.$

The first order conditions of the above maximization problems give rise to the following best-response functions:

$$q_1(q_2, \hat{c}_U) = \frac{1 - \hat{c}_U - \theta q_2}{2}, \quad q_2(q_1, w) = \frac{1 - w - \theta q_1}{2}. \quad (16)$$

Solving the system of best-response functions in (16), we obtain the last-stage subgame equilibrium outcomes as functions of $w$ and $\hat{c}_U$:

$$q_1(w, \hat{c}_U) = \frac{(2 - \theta) + \theta w - 2\hat{c}_U}{4 - \theta^2}, \quad q_2(w, c_{U/2}) = \frac{(2 - \theta) + \theta \hat{c}_U - 2w}{4 - \theta^2},$$

$$Q(w, \hat{c}_U) = q_1(w, \hat{c}_U) + q_2(w, \hat{c}_U) = \frac{2 - w - \hat{c}_U}{2 + \theta}, \quad (17)$$

$$p_1(w, \hat{c}_U) = \frac{(2 - \theta) + \theta w + (2 - \theta^2)\hat{c}_U}{4 - \theta^2}, \quad p_2(w, \hat{c}_U) = \frac{(2 - \theta) + \theta \hat{c}_U + (2 - \theta^2)w}{4 - \theta^2}.$$

In light of our subsequent analysis, we make the following two observations regarding the last-stage subgame equilibrium outcomes in the pre- and post-merger case(s). For any given level of the input price, (i) the merger does not affect downstream equilibrium outcomes when $\hat{c}_U = c_{U1}$ and (ii) the merger increases total output and decreases both final-good prices when $\hat{c}_U = c_{U2}$.

The fixed fee is set to fully extract $D2$’s profits (see (13)) and thus the input price is chosen to maximize industry profits,

$$\max_w [p_1(w, \hat{c}_U) - \hat{c}_U]q_1(w, \hat{c}_U) + [p_2(w, \hat{c}_U) - \hat{c}_U]q_2(w, \hat{c}_U) \quad (18)$$

From the first order condition of (18), we obtain the equilibrium input price:
\[
W^M(c_U) = \frac{(2 - \theta^2)\theta + c_U(8 - 4\theta - 2\theta^2 - \theta^3)}{2(4 - 3\theta^2)} > c_U. \quad (19)
\]

The expression in (19) implies that while an independent \(U2\) subsidizes the input purchases of \(D2\), in the post-merger case the equilibrium input price is always above the upstream marginal cost.

We consider first the case where the independent upstream firm is less efficient than the upstream division of the vertically integrated firm. The effects of the merger on input price, final-good prices and consumer surplus are summarized in the next Proposition.

**Proposition 2.** When \(c_{u1} < c_{u2}\), a horizontal merger between the vertically integrated firm and the independent upstream supplier decreases the input and final-goods prices and increases consumer surplus if and only if

\[
\frac{1 - c_{u2}}{1 - c_{u1}} < \gamma_1(\theta) = \frac{8 - 4\theta - 4\theta^2 + \theta^3}{2(4 - 3\theta^2)}.
\]

When \(U2\) is less efficient than \(U1\), the merger creates efficiency gains that, while they lower the cost of the upstream production directed to the independent downstream rival, they do not affect the cost of the upstream production directed to the downstream division of the merged firm. This implies that the merger affects downstream equilibrium only through one channel, the input price. Concerning the merger’s impact on the latter, two effects are in work. By ending the subsidization of \(D2\), the merger tends to raise, *ceteris paribus*, the input price, which induces \(D2\) to behave less aggressively and thus pushes both final-good prices upwardly. At the same time, however, the merger creates efficiency gains in the supply of the input to the independent downstream firm causing the input price to fall. When these efficiency gains are sufficiently large to outweigh the former effect, the merger results to an input-price reduction, which causes both final-good prices to decrease thereby making consumers better off.

Consider now the case where the independent upstream firm is more efficient than the upstream division of the vertically integrated firm. The effects of the merger on input price, final-good prices and consumer surplus are summarized in the next Proposition.
Proposition 3. When \( c_{U1} > c_{U2} \), a horizontal merger between the vertically integrated firm and the independent upstream supplier:

(i) always increases the input price and the final-good price of the independent downstream firm,

(ii) decreases the final-good price of the vertically integrated firm if and only if

\[
\frac{1-c_{U1}}{1-c_{U2}} < \gamma_1(\theta) = \frac{2(8 - 14\theta^2 + \theta^3 + 5\theta^4)}{(4 - 3\theta^2)^2},
\]

(iii) increases consumer surplus if and only if

\[
\frac{1-c_{U1}}{1-c_{U2}} < \gamma_3(\theta) = \frac{2((2 - \theta^3)\sqrt{A} - \theta^3)}{16 - 20\theta^2 + 5\theta^4},
\]

with \( A = (64 - 64\theta - 96\theta^2 + 80\theta^3 + 52\theta^4 - 20\theta^5 - 15\theta^6)/(4 - 3\theta^2) > 0 \) and \( \gamma_3(\theta) < \gamma_2(\theta) \).

When the independent upstream firm is more efficient than the upstream division of the vertically integrated firm, on the one hand, the merger does not lower the cost of the upstream production directed to the independent downstream firm, leaving at play only the vertical foreclosure effect. Hence, as in the case of upstream cost symmetry, the input price always increases pulling with it the final-goods prices. On the other hand, the merger also creates efficiency gains in the upstream production directed to the downstream division of the merged firm, thus tending to decrease both final-good prices.

As it turns out, the final-good price of the independent downstream firm always increase due to the merger irrespective of the magnitude of the efficiency gains. However, when the efficiency gains are sufficiently large, the final-good price of the vertically integrated firm decreases and consumer surplus increases as a result of the merger; as indicated in Proposition 3, the potential decrease in the final-good price of the vertically integrated firm is a necessary (but not sufficient) condition for consumer surplus to increase.

We make two final remarks regarding both cases of upstream cost asymmetry considered above. First, the merger’s positive effect on consumer surplus is more likely the more differentiated final goods are. This is so because the higher is the degree of product differentiation the weaker the vertical partial foreclosure effect is. In the extreme case where
final goods are independent in demand, the vertical foreclosure effect vanishes and thus the merger always increases consumer surplus.5

Second, the merger is always beneficial for the merging parties. Since even a merger between symmetric upstream firms is beneficial for the merging parties (see Section 3), a merger between asymmetric firms increases their profits even more, due to efficiency gains it creates, and this, irrespectively of whether these gains lower the input cost of the downstream division of the merged firm or the independent downstream rival.

5. Conclusions

We have studied upstream horizontal mergers when one of the merging parties is a vertically integrated firm. We have considered a two-tier market consisting of two competing vertical chains, with one upstream and one downstream firm in each chain, assuming that one vertical chain is vertically integrated whereas the other chain is vertically separated.

We have shown that under upstream cost symmetry, a horizontal merger between the independent and the vertically integrated input producer(s) raises input price and induces a less aggressive behavior of the remaining independent downstream producer, shifting final-good sales towards the downstream affiliate of the integrated firm. The higher input price ultimately induces a rise in the final-good prices and fall in total output, thus making consumers worse off. Since in the pre-merger situation the vertically integrated firm sells no input in the open market, the latter is, and remains post-merger, a monopoly. Hence, the merger does not affect concentration in the upstream merchant market, and its negative impact on consumer surplus stems solely from a vertical partial foreclosure effect.

Taking into account upstream cost asymmetries, we have assumed that, in the post-merger case, the more efficient firm transfers its technology to the less efficient firm, allowing for the merger to create efficiency gains. When the independent upstream firm is less efficient than the upstream division of the vertically integrated firm, these gains lower the cost of the upstream production directed to the independent downstream rival. We have demonstrated that when these efficiency gains are sufficiently large, then the input price and final-good prices decrease and consumer surplus increases as a result of the merger. On the other hand,

5Note that when products are totally differentiated, i.e., $\theta = 0$, from Propositions 2 and 3, we have that $\gamma_I(0) = 1$ and $\gamma_I(0) = 1$. The former implies that the merger increases consumer surplus when $(1 - c_{ii})/(1 - c_{vi}) < 1$ which is always true given that $c_{ii} < c_{v2}$, whereas the latter implies that the merger increases consumer surplus when $(1 - c_{ii})/(1 - c_{vi}) < 1$ which is also always true given that $c_{ii} > c_{v2}$. 

16
when the independent upstream firm is more efficient than the upstream division of the vertically integrated firm, the merger lowers the cost of the upstream production that is directed to the downstream division of the merged firm. We have shown that when these efficiency gains are sufficiently large, consumer surplus may increase due to the merger even though the input price and the final-good price of the independent downstream firm always increase.

While our formal analysis is based on two-part tariff contracts and downstream quantity competition, its results remain qualitatively robust under the alternative assumptions of linear contracting and/or downstream price competition. Future research may consider alternative industry settings with a larger number of competing vertical chains (both integrated and separated) and/or non-exclusive relations between upstream and downstream firms (the latter will allow for the integrated firm’s participation in merchant input market, either as a seller, or even as a strategic buyer), in order to examine the impact of such type of mergers under different market structures.

Appendix A: Upstream symmetric costs

The last-stage subgame equilibrium final-good outputs and prices as functions of the input price are given by: \( \hat{q}_1(w), \hat{q}_2(w), \hat{p}_1(w) = p_1[\hat{q}_1(w), \hat{q}_2(w)] \) and \( \hat{p}_2(w) = p_2[\hat{q}_1(w), \hat{q}_2(w)] \). As noted in subsection 3.2, these equilibrium outcomes are the same regardless of whether the merger occurs or not. We derive here the properties described in (3).

Note first that \( \hat{q}_1 \) depends on \( w \) only indirectly through \( \hat{q}_2 \) so that \( \hat{q}_1(w) = q_1[\hat{q}_2(w)] \) and \( d\hat{q}_1(w)/dw = (dq_1/dq_2)(d\hat{q}_2(w)/dw) \). Given strategic substitutability (see Assumption 2) it holds that \( dq_1/dq_2 < 0 \). It is then straightforward that \( d\hat{q}_1(w)/dw \) and \( d\hat{q}_2(w)/dw \) have opposite signs.

We next show that \( d\hat{q}_2(w)/dw < 0 \).

The last-stage subgame equilibrium final-good outputs \( \hat{q}_1(w) \) and \( \hat{q}_2(w) \) must satisfy the first-order conditions in the downstream market, therefore (2) can be written as:

---

6In both these cases, however, Lemma 1 is no longer valid. Under linear contracting, and irrespective of the mode of downstream competition, the pre-merger equilibrium input price is always higher than upstream marginal cost due to the absence of fixed fees. Under downstream price competition, and irrespective of the contract type used, the independent upstream firm no longer wants to induce an aggressive behaviour in the downstream market since prices, unlike quantities, are strategic complements, and thus downstream production is not subsidized.
\[ p_2[\hat{q}_1(w), \hat{q}_2(w)] + \hat{q}_2(w) \frac{\partial p_2}{\partial q_2} - w - c_2 = 0. \]

Using the implicit function theorem in the above expression, we obtain:

\[
\frac{d\hat{q}_2(w)}{dw} = \frac{1}{2 \frac{\partial p_2}{\partial q_2} + \frac{\partial p_1}{\partial q_1} \frac{dq_1}{d\hat{q}_2}} = \frac{1}{\frac{\partial^2 \pi_{D2}}{\partial q_2^2}} < 0,
\]

where the denominator \( \frac{\partial^2 \pi_{D2}}{\partial q_2^2} \) is negative due to Assumption 1. Therefore, it holds that \( d\hat{q}_2(w)/dw < 0 \) and \( d\hat{q}_1(w)/dw > 0 \). Moreover, given that \( |dq_1/d\hat{q}_2|<1 \), it also holds that \( d\hat{q}_1(w)/dw < |d\hat{q}_2(w)/dw| \). The last inequality implies that an increase in the input price decreases the total quantity supplied in the downstream market, i.e., \( d\hat{Q}(w)/dw < 0 \).

Regarding the effect of \( w \) on \( \hat{p}_2 \), we have that,

\[
\frac{d\hat{p}_2(w)}{dw} = \frac{\partial p_2}{\partial q_2} \frac{d\hat{q}_2(w)}{dw} + \frac{\partial p_2}{\partial q_1} \frac{dq_1}{d\hat{q}_2} \frac{d\hat{q}_2(w)}{dw} = \frac{\partial p_2}{\partial q_2} \frac{d\hat{q}_2(w)}{dw} \left[ \frac{\partial p_2}{\partial q_2} + \frac{\partial p_2}{\partial q_1} \frac{dq_1}{d\hat{q}_2} \right] > 0,
\]

where the bracketed term in the last inequality is negative since \( |\partial p_2/\partial q_2| > |\partial p_2/\partial q_1| \) and \( |dq_1/d\hat{q}_2| < 1 \).

Finally, regarding the effect of \( w \) on \( \hat{p}_1 \), we have that,

\[
\frac{d\hat{p}_1(w)}{dw} = \frac{d\hat{q}_2(w)}{dw} \left[ \frac{\partial p_1}{\partial q_2} + \frac{\partial p_1}{\partial q_1} \frac{dq_1}{d\hat{q}_2} \right] > 0.
\]

An increase in \( w \) affects indirectly \( \hat{p}_1 \) through \( \hat{q}_2 \) in two ways: On the one hand, a decrease in \( \hat{q}_2 \) increases \( \hat{p}_1 \) - a second order effect. On the other hand, a decrease in \( \hat{q}_2 \) leads to an increase in \( \hat{q}_1 \), which in turn decreases \( \hat{p}_1 \) - a third order effect. It is natural to assume that the second order effect is of greater importance than the third order effect implying that \( \hat{p}_1 \) increases with \( w \).

**Appendix B: Upstream cost asymmetry**
We first characterize the final equilibrium outcomes. In the pre-merger case, equilibrium outcomes are as follows:

\[
q_1^*(c_{U1}, c_{U2}) = \left[ p_1^*(c_{U1}, c_{U2}) - c_{U1} \right] = \frac{(4 - 2\theta - \theta^2) + 2\theta c_{U2} - (4 - \theta^2)c_{U1}}{4(2 - \theta^2)} ,
\]

\[
q_2^*(c_{U1}, c_{U2}) = \left[ p_2^*(c_{U1}, c_{U2}) - w^*(c_{U1}, c_{U2}) \right] = \frac{(2 - \theta) + \theta c_{U1} - 2c_{U2}}{2(2 - \theta^2)} ,
\]

\[
CS^*(c_{U1}, c_{U2}) = \frac{(16 - 20\theta^2 + 5\theta^4)(1-c_{U1})^2 + 4(4-3\theta^2)(1-c_{U2})^2 + 4\theta^3(1-c_{U1})(1-c_{U2})}{32(2-\theta^2)^2}.
\]

In the post-merger case, equilibrium outcomes are as follows:

\[
q_1^{**}(\hat{c}_U) = \left[ p_1^{**}(\hat{c}_U) - \hat{c}_U \right] = \frac{(4 - 2\theta - \theta^2)(1-\hat{c}_U)}{2(4-3\theta^2)} ,
\]

\[
q_2^{**}(\hat{c}_U) = \left[ p_2^{**}(\hat{c}_U) - w^{**}(\hat{c}_U) \right] = \frac{2(1-\theta)(1-\hat{c}_U)}{4 - 3\theta^2} ,
\]

\[
CS^{**}(\hat{c}_U) = \frac{(8 - 4\theta - 3\theta^2)(1-\hat{c}_U)^2}{8(4 - 3\theta^2)} .
\]

B.1. The case of \( \hat{c}_U = c_{U1} < c_{U2} \).

First, we derive the condition under which final-good quantities are positive under both the pre- and post-merger case(s), and then show that \( w^{**}(c_{U1},c_{U2}) < c_{U2} \) and \( w^{**}(c_{U1}) > c_{U1} \).

It is straightforward that both \( q_1^{**}(c_{U1}) \) and \( q_2^{**}(c_{U1}) \) are positive whenever \( c_{U1} < 1 \). The requirement that \( q_2^{**}(c_{U1},c_{U2}) > 0 \) reduces to:

\[
c_{U1}(c_{U2}, \theta) \equiv \frac{2c_{U2} - (2-\theta)}{\theta} < c_{U1} .
\]
Given the assumption that \( c_{u1} < c_{u2} \), it must hold that \( c_{u1}(c_{u2}, \theta) < c_{u2} \). It is straightforward that the latter condition is always true whenever \( c_{u2} < 1 \). Therefore, condition (B3) can be written as

\[
\frac{2c_{u2} - (2 - \theta)}{\theta} < c_{u1} < c_{u2} < 1, \tag{B4}
\]

or, rearranging the terms in the first inequality, as

\[
\frac{1 - c_{u2}}{1 - c_{u1}} > \gamma_{1}(\theta) = \frac{\theta}{2}. \tag{B5}
\]

The requirement that \( q^*_1(c_{u1}, c_{u2}) > 0 \) reduces to \( c_{u1} < [(4 - 2\theta - \theta^2) + 2\theta c_{u2}] / 4 - \theta^2 \), which is always true since for \( c_{u2} < 1 \) it holds that \( c_{u2} < [(4 - 2\theta - \theta^2) + 2\theta c_{u2}] / 4 - \theta^2 \). Therefore, condition (B4) or (B5) guarantees that final-good quantities are positive under both the pre- and post-merger case(s).

Using (15), the requirement that \( w^*(c_{u1}, c_{u2}) < c_{u2} \) reduces to \( [2c_{u2} - (2 - \theta)]/\theta < c_{u1} \), which is always true given (B4). Similarly, using (19), the requirement that \( w^*(c_{u1}) > c_{u1} \) reduces to \( c_{u1} < 1 \), which is always true given (B4).

**Proof of Proposition 2.** We define \( \Delta_w = w^*(c_{u1}, c_{u2}) - w^*(c_{u1}) \). Using (16) and (18), we obtain:

\[
\Delta_w = \frac{(4 - \theta^2)(1 - c_{u1})(8 - 4\theta - 4\theta^2 + \theta^3) - 2(4 - 3\theta^2)(1 - c_{u2})}{4(4 - 3\theta^2)(2 - \theta^3)}. 
\]

It is straightforward that \( \Delta_w > 0 \) whenever the bracketed term in the numerator of the above expression is positive, which yields,

\[
\frac{1 - c_{u2}}{1 - c_{u1}} < \gamma_{1}(\theta) = \frac{8 - 4\theta - 4\theta^2 + \theta^3}{2(4 - 3\theta^2)}. \tag{B6}
\]
It can be easily checked that \( \gamma_1(\theta) > \overline{\gamma}_1(\theta) \) which implies that the results in Proposition 2 hold when both firms are active in the downstream market.

Given that for any given level of input prices the downstream equilibrium outcomes are the same in both the pre- and post-merger cases (see (12) and (17)), it is straightforward that the merger’s overall effect on final-good prices, total output and consumer surplus is solely determined by its effect on the input price. Therefore, whenever condition (B6) holds, both final-good prices decrease and total output increases, implying an increase in consumer surplus. ■

*B.2. The case of* \( c_{U1} > c_{U2} = \hat{c}_U \).*

First, we derive the condition under which final-good quantities are positive under both the pre- and post-merger case(s), and then show that \( q_1^{MR}(c_{U1}, c_{U2}) < c_{U2} \) and \( q_2^{MR}(c_{U1}, c_{U2}) > c_{U2} \).

It is straightforward that both \( q_1^{MR}(c_{U2}) \) and \( q_2^{MR}(c_{U2}) \) are positive whenever \( c_{U2} < 1 \). The requirement that \( q_1^{MR}(c_{U1}, c_{U2}) > 0 \) reduces to:

\[
\begin{align*}
    c_{U2}(c_{U1}, \theta) &\equiv \frac{(4 - \theta^2)c_{U1} - (4 - 2\theta - \theta^3)}{2\theta} < c_{U2}. \\
    &\quad \text{(B7)}
\end{align*}
\]

Given the assumption that \( c_{U1} > c_{U2} \), it must hold that \( c_{U2}(c_{U1}, \theta) < c_{U1} \). It is straightforward that the latter condition is always true whenever \( c_{U1} < 1 \). Therefore, condition (B7) can be written as,

\[
\begin{align*}
    \frac{(4 - \theta^2)c_{U1} - (4 - 2\theta - \theta^3)}{2\theta} < c_{U2} < c_{U1} < 1, \\
    &\quad \text{(B8)}
\end{align*}
\]

or, rearranging the terms in the first inequality, as

\[
\begin{align*}
    \frac{1 - c_{U1}}{1 - c_{U2}} > \overline{\gamma}_1(\theta) = \frac{2\theta}{4 - \theta^2}, \\
    &\quad \text{(B9)}
\end{align*}
\]
The requirement that \( q_s^*(c_{U_1}, c_{U_2}) > 0 \) reduces to \( c_{U_2} < [(2 - \theta) + \theta c_{U_1}] / 2 \), which is always true since for \( c_{U_1} < 1 \) it holds that \( c_{U_2} < [(2 - \theta) + \theta c_{U_1}] / 2 \). Therefore, condition (B8) or (B9) guarantees that final-good quantities are positive under both the pre- and post-merger case(s).

Using (15), the requirement that \( w^s(c_{U_1}, c_{U_2}) < c_{U_2} \) reduces to \( \frac{[(4 - \theta^2)c_{U_1} - (4 - 2\theta - \theta^3)]}{2\theta} < c_{U_2} \), which is always true given (B8). Similarly, using (19), the requirement that \( w^m(c_{U_2}) > c_{U_2} \) reduces to \( c_{U_2} < 1 \), which is always true given (B8).

**Proof of Proposition 3.** (i) Given that \( w^s(c_{U_1}, c_{U_2}) < c_{U_2} \) and \( w^m(c_{U_2}) > c_{U_2} \), it is straightforward that \( w^s(c_{U_1}, c_{U_2}) < w^m(c_{U_2}) \).

(ii) From (B1) and (B2), and using (15) and (19), we have that:

\[
p_1^m(c_{U_2}) - p_1^s(c_{U_1}, c_{U_2}) = \frac{(4 - 3\theta^2)(1 - c_{U_1}) - 2(1 - c_{U_2})(8 - 14\theta^2 + \theta^3 + 5\theta^4)}{4(4 - 3\theta^2)(2 - \theta^2)},
\]  

(B10)

and

\[
p_2^m(c_{U_2}) - p_2^s(c_{U_1}, c_{U_2}) = \frac{\theta[(4 - 3\theta^2)(1 - c_{U_1}) - 2\theta(1 - \theta)(1 - c_{U_2})]}{4(4 - 3\theta^2)}.
\]  

(B11)

First, we derive the condition under which \( p_1^m(c_{U_2}) < p_1^s(c_{U_1}, c_{U_2}) \) and then show that it always holds \( p_2^m(c_{U_2}) > p_2^s(c_{U_1}, c_{U_2}) \). The expression in (B10) is negative whenever its numerator is negative, i.e.,

\[(4 - 3\theta^2)(1 - c_{U_1}) - 2(1 - c_{U_2})(8 - 14\theta^2 + \theta^3 + 5\theta^4) < 0,
\]

which yields,

\[
\frac{1 - c_{U_1}}{1 - c_{U_2}} < \gamma_2(\theta) = \frac{2[8 - 14\theta^2 + \theta^3 + 5\theta^4]}{(4 - 3\theta^2)^2}.
\]

After some straightforward calculations, it can be easily checked that the above expression is always true given (B9).
The expression in (B11) is positive whenever the bracketed term in its numerator is positive, i.e.,

$$(4 - 3\theta^2)(1 - c_{U1}) - 2\theta(1 - \theta)(1 - c_{U2}) > 0,$$

yielding,

$$\frac{1 - c_{U1}}{1 - c_{U2}} > \frac{2\theta(1 - \theta)}{(4 - 3\theta^2)},$$

which is always true given (B9).

(iii) Regarding consumer surplus, we define $\Delta CS = CS_{MS}(c_{U2}) - CS_{CS}(c_{U1}, c_{U2})$. Using (B1) and (B2), and solving $\Delta CS = 0$ for $(1 - c_{U1})$ we obtain two roots:

$$(1 - c_{U1})_1 = \frac{2(1 - c_{U2})[(2 - \theta^2)\sqrt{A} - \theta^3]}{16 - 20\theta^2 + 5\theta^4} \quad \text{and} \quad (1 - c_{U1})_2 = -\frac{2(1 - c_{U2})[(2 - \theta^2)\sqrt{A} + \theta^3]}{16 - 20\theta^2 + 5\theta^4},$$

with $A = (64 - 64\theta - 96\theta^2 + 80\theta^3 + 52\theta^4 - 20\theta^5 - 15\theta^6)/(4 - 3\theta^2) > 0$. Since we require that $c_{U1} < 1$, we disregard the second root since it is always negative. From the first root, we obtain that $\Delta CS > 0$ whenever

$$\frac{1 - c_{U1}}{1 - c_{U2}} < \gamma_2(\theta) = \frac{2[(2 - \theta^2)\sqrt{A} - \theta^3]}{16 - 20\theta^2 + 5\theta^4}.$$

After some tedious but straightforward calculations, it can be shown that $\gamma_2(\theta) < \gamma_3(\theta) < \gamma_4(\theta)$, which implies that (i) a necessary (but not sufficient) condition for consumer surplus to increase is that $p_1$ falls and (ii) the results in Proposition 3 hold when both firms are active in the downstream market. ■

References


