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Abstract. We analyze vertical integration incentives in a bilaterally duopolistic industry with bargaining in the input market. Vertical integration incentives are a combination of horizontal integration incentives upstream and downstream and depend on the strength of substitutability and complementarity and the shape of the unit cost function. Under particular circumstances, vertical integration can convey more bargaining power to the merged entity than a horizontal merger to monopoly. In a bidding game for an exogenously determined target firm, a vertical merger can dominate a horizontal one, while pre-emption does not occur.

Résumé. Une perspective de négociation sur l'intégration verticale. Nous analysons les incitations à l'intégration verticale dans une industrie duopolistique bilatérale avec négociation sur le marché des facteurs de production. Les incitations à l'intégration verticale sont une combinaison des incitations à l'intégration horizontale en amont et en aval et dépendent de la force de la substituabilité/complémentarité et de la forme de la fonction de coût unitaire. Dans certaines circonstances, l'intégration verticale peut conférer à l'entité fusionnée un pouvoir de négociation plus important qu'une fusion horizontale en vue d'un monopole. Dans un jeu d'enchères pour une entreprise dont l'objectif est déterminé de l'extérieur, une fusion verticale peut dominer une fusion horizontale, tandis que la préemption ne se produit pas.

JEL classification: L13, L22, L42

1. Introduction

Competition policy traditionally looks at vertical and horizontal mergers from different perspectives. While horizontal mergers are often regarded as being motivated

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This paper benefitted from helpful comments from the editor Zhiqi Chen, two anonymous referees and seminar participants at Berlin Humboldt University, the Düsseldorf Institute for Competition Economics, the German Institute for Economic Research (DIW Berlin) and the 2018 CISS in Montenegro. An earlier version of this article circulated under the title "Bargaining, Vertical Mergers and Entry." The views expressed in this article are solely those of the authors and may not, under any circumstances, be regarded as representing an official position of the European Commission. This is personal research that is not related to any activity of the European Commission. Funding by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under project 235577387/GRK1974 is gratefully acknowledged.
Canadian Journal of Economics / *Revue canadienne d'économique* 2024 57(1)
February 2024. / *Février 2024.*

24 / pp. 199–224 / DOI: 10.1111/caje.12700

by the intent to reduce competition, it is more frequently argued that vertical integration is driven by efficiencies, for example, by eliminating double markups, reducing transaction costs or solving some variant of the holdup problem. This is explicitly stated in paragraph 11 of the EC non-horizontal merger guidelines, recognizing that "[n]on-horizontal mergers are generally less likely to significantly impede effective competition than horizontal mergers" (European Union, 2008). A similar view emerges in the Vertical Merger Guidelines of the U.S. Department of Justice and the Federal Trade Commission, which note that "[v]ertical mergers... also raise distinct considerations [than do horizontal mergers].... For example, vertical mergers often benefit consumers through the elimination of double marginalization, which tends to lessen the risks of competitive harm."[1]

At least some of this sharp distinction between horizontal and vertical mergers may lie in the tradition of economic analysis to ignore the ability of downstream firms to influence upstream markets. Yet in perhaps most vertically related industries, supply conditions are determined through bilateral bargaining, where downstream firms may have the ability to actively negotiate contracts with suppliers. Much research has been devoted to how horizontal integration can tip bargaining in favour of the merging parties. This research also gave rise to the recent heated debate on buyer power in the antitrust arena. The question of how vertical integration can affect bargaining outcomes has, however, remained significantly less studied.

This article intends to take a step toward closing this gap. We investigate the driving forces behind vertical integration, its effects and social desirability while taking into account that transactions between businesses in input markets arise as a result of bilateral bargaining. To focus on the shift in bargaining power from vertical integration, we apply a model that abstracts away from product market effects such as changes in prices.[2]

We provide conditions for vertical mergers to take place regarding the strength of substitutability or complementarity between final goods and the shape of the unit cost function. We then compare vertical to horizontal integration incentives and find that vertical merger incentives are a combination of horizontal merger incentives upstream and downstream, so that both types of mergers are closely related from a pure bargaining perspective.

We also analyze the strategic incentives of firms to merge in order to pre-empt a potentially harmful merger by a competitor. To investigate this question, we propose a bidding game in which an exogenously determined target firm is up for sale to the highest bidder, to either a horizontally or a vertically related firm. We show that vertical merger incentives can be stronger than horizontal ones. Consequently, a horizontal merger to monopoly may convey less bargaining power to the merged entity than a vertical integration. In addition, we find that vertical mergers are never motivated by pre-emptive bargaining power considerations.

Our framework is relevant for the analysis of vertical mergers in concentrated input markets, where *both* suppliers and buyers have considerable bargaining power. One example is the US market for pay TV, which is characterized by an oligopolistic structure on both market sides. Upstream firms produce video content that is licensed as TV channels to downstream firms, which in turn bundle and sell TV programs to households through various channels such as cable or satellite (see Rogerson, 2020; Shapiro, 2021, for details). It is

1 See section 1 of the Vertical Merger Guidelines (U.S. Department of Justice and the Federal Trade Commission, 2020).

2 Isolating bargaining motivation of mergers from price effects is useful for reasons of tractability. We can also show that adding downstream competition leaves our qualitative results intact. Details are provided in the online appendix.

well documented that the terms of supply (e.g., licensing fees) are determined by bargaining between upstream and downstream firms (see Salop, 2018; Rogerson, 2020; Shapiro, 2021). Consistent with this, the media has documented temporary bargaining breakdowns.[3] The market faced multiple vertical mergers in the two past decades, including the mergers of News Corp/DirecTV, Comcast/NBCU and AT&T/Time Warner. For example, in the AT&T/Time Warner case, several Time Warner subsidiaries (e.g., Warner Bros.) produced TV content that they sold to the AT&T subsidiary DirecTV and DirecTV's competitors like Comcast or Charter. Thus, the vertical merger led to a structure where the integrated upstream firms not only provide TV content to their integrated partner DirecTV but also negotiate with downstream rivals about the provision of their content.

As discussed by Rogerson (2020, p. 411), because "bargaining power is so clearly present on both sides of the market, it is not surprising that government authorities have begun to focus their analysis on competitive theories of harm that take the effects of bargaining into account." While the Federal Communications Commission based its arguments largely on the traditional raising rivals' costs (RRC) theory and input foreclosure paradigms in the News Corp/DirecTV case in 2003, these theories have been successively challenged in subsequent merger cases by a bargaining-based theory, called bargaining leverage over rivals (BLR) theory (Rogerson, 2020). The BLR effect arises because a vertical merger increases the disagreement payoff of the upstream firm, which induces higher retail prices to the detriment of consumers. If bargaining between the supplier and a non-integrated retailer breaks down, the downstream affiliate will earn some extra profit if the input is completely withheld from the rival retailer. Because of vertical integration, the integrated supplier internalizes this positive effect. This improves its threat point and thus bargaining power vis-à-vis the non-integrated retailer.

Two important features distinguish the BLR theory from the RRC theory. First, while the RRC effect arises in set-ups where bargaining power exists only on the upstream market side, the BLR theory arises from a bargaining framework in which both sides can have (some) bargaining power. Second, the BLR effect does not hinge on the assumption that upstream prices are set before downstream prices, which is required by the RRC theory. Rogerson (2020) also derives a simple statistic, called vertical GUPPI, that can be estimated on the basis of widely available data and that can be used to assess the potential harm due to the BLR effect pre-merger. In the context of our paper, it is worth noting that our effects can also be thought of as originating from a change in the bargaining leverage over rivals. However, while in Rogerson (2020) this effect is related to competitive externalities in the downstream market, our effects do not originate from downstream competition.

In our model of two upstream suppliers and two downstream (monopoly) retailers, we get two additional effects of vertical integration that also create bargaining leverage over rivals. First, the upstream supplier's disagreement point when bargaining with the non-integrated retailer is improved when unit costs are increasing. A breakdown in the bargaining then allows the integrated firm to realize an extra profit from increasing sales at the affiliated retailer. Second, the integrated retailer benefits from an improved disagreement point when bargaining with the non-integrated supplier, whenever the goods are substitutes. Here, a breakdown in the bargaining creates an extra profit resulting from the demand increase when

3 See, for example, the newsflash "TV tussle: DirecTV, Tegna dispute turns TV channels dark in 51 markets including Houston, Seattle," available at https://eu.usatoday.com/story/tech/2020/12/02/tv-directv-tegna-dispute-results-channel-outages-51-markets/3794473001/.

the rival supplier's good is not available. Vertical integration leads to a better internalization of this extra profit, while it remains incomplete under separation.

Rogerson (2020) and our paper are part of a large strand of literature analyzing vertical merger incentives. Given that upstream and downstream firms have (at least some) market power, vertical integration can be privately and socially desirable because of its potential to reduce the double markup problem that arises under linear wholesale prices. However, Luco and Marshall (2020) provide a recent empirical analysis showing that the elimination of double marginalization through vertical integration can also raise anti-competitive concerns in multi-product industries. Other economic theories focus on the anti-competitive effects of vertical mergers by referring to foreclosure and raising rivals' costs effects (see, for example, Salinger, 1988; Ordover et al., 1990; Inderst and Valletti, 2011) or on the use of vertical integration to solve commitment problems (see, for example, Hart et al., 1990).[4] Finally, other contributions discuss firms' incentives to stay vertically separated (see, for example, Bonanno and Vickers, 1988).

An important representative of this strand of literature for our work is De Fontenay and Gans (2005b). They focus on vertical merger incentives in a bargaining framework similar to ours and compare outcomes under upstream competition and monopoly. We extend their analysis to complementary final goods and decreasing unit costs. Doing so yields markedly different results for vertical merger incentives, two of which stand out. First, in their baseline model (with no competitive externalities downstream) and given upstream competition, vertical integration is always preferred to non-integration. Our analysis confirms this result for the particular case of substitute goods and increasing unit costs, but we obtain different results for complementary goods and/or decreasing unit costs. Second, they show that vertical integration incentives are larger under upstream competition than under upstream monopoly, while we show that the impact of upstream competition on vertical integration incentives can go either way.

Finally, two other papers are worth mentioning. First, our analysis builds on the model of Inderst and Wey (2003), who analyze horizontal merger incentives upstream and downstream as well as the choice of a manufacturer between two technologies influencing production costs. One of their main findings is that upstream merger incentives depend on the substitutability/complementarity, while downstream merger incentives depend on the shape of the cost function. Our analysis reveals that the same incentives are present in vertical merger considerations, so that vertical merger incentives can be regarded as a combination of merger incentives upstream and downstream.

Second, our paper provides a novel perspective on Segal (2003), who discusses various contracts among substitute and complementary firms in the context of cooperative games with random-order values. Our definition of mergers corresponds to what Segal (2003) refers to as collusion. Segal shows that a merger between substitutes likely hurts non-indispensable outsiders, while a merger between complements benefits them. Our model generates additional insights by assigning control of different resources to different firms. While in Segal (2003) firms differ only in terms of the value they generate to the industry as a whole, in our model, these differences are systematic for upstream and downstream firms, i.e., suppliers control production and retailers are gatekeepers to consumers and hence control demand.

4 The approach of Hart et al. (1990) has been extended to analyze the effects of vertical integration on investment incentives (see, for example, Bolton and Whinston, 1993; Stole and Zwiebel, 1996; Baake et al., 2004; Choi and Yi, 2000). See also Chen (2019) for a recent analysis of how changes in bargaining power affect the incentives of an upstream firm to invest in quality and product variety.

This gives rise to different incentives for horizontal and vertical mergers depending on the shape of average costs and demand.

The remaining article proceeds as follows. Section 2 introduces the model. In section 3, we apply the framework to analyze vertical merger incentives. Section 4 compares horizontal and vertical merger incentives in more detail and derives conditions determining which of these incentives is strongest. Finally, section 5 concludes. All proofs are in appendix A1.

2. Model

Our set-up follows Inderst and Wey (2003) and extends their analysis to vertical mergers. Consider an industry with two upstream suppliers, $s \in S^0 = \{A, B\}$, and two downstream retailers, $r \in R^0 = \{a, b\}$. We denote the set of all firms by $\Omega = S^0 \cup R^0$ and subsets by Ψ.

Each supplier controls the production of one input, with inputs being differentiated. Supplier s incurs costs of production, given by $C_s(q_{sr} + q_{sr'})$, where q_{sr} is the quantity exchanged between s and r. We use primes (s' and r') to refer to the alternative supplier and retailer, respectively. We allow the average unit costs, given by $\overline{C}_s(q) = C_s(q)/q$, to be either strictly increasing or decreasing in q[5].

Downstream retailers procure inputs from the suppliers and turn them into final goods that they sell to final consumers. For simplicity, we assume that one unit of an input is turned into one unit of a final good. Because the inputs are differentiated, the final goods are also differentiated.

Demand at the retailers is independent, hence, there are no competitive externalities downstream.[6] This means that changes in the industry structure affect only the distribution of rents but not product market outcomes such as the (input and output) quantities, prices or the total surplus generated. This is an important simplification: while it abstracts away from short run price effects, which are typically a key concern in antitrust analysis, doing so also allows us to isolate the pure bargaining effects of various vertical and horizontal mergers. We relax the assumption in the online appendix and show that our main finding remains intact if we allow downstream externalities.

Retailer r faces the indirect demand function $p_{sr}(q_{sr}, q_{s'r})$ when selling the final good produced from the input of supplier s. We consider cases where the two final goods are either substitutes or complements at each outlet.

The degree of substitutability/complementarity and the degree of strictly increasing/decreasing unit costs will be the important determinants in our analysis. To simplify the presentation of our results, let $\Delta_p(q) := p_{sr}(q, q) - p_{sr}(q, 0)$ and $\Delta_C(q) := \overline{C}_s(2q) - \overline{C}_s(q)$ for $q > 0$. If final goods are strict complements (substitutes), then $\Delta_p(q) > 0$ ($\Delta_p(q) < 0$) for all $q > 0$ and we simply write $\Delta_p > 0$ ($\Delta_p < 0$). Similarly, if unit costs are strictly increasing (decreasing), then $\Delta_C(q) > 0$ ($\Delta_C(q) < 0$) for all $q > 0$ and we write $\Delta_C > 0$ ($\Delta_C < 0$).

Some of our results rely on a comparison between $\Delta_p(q)$ and $\Delta_C(q')$ for particular $q, q' > 0$ that result from the corresponding proofs. To simplify the notation, we omit the arguments in the main text and use the notation $\Delta_p \gtrless \Delta_C$.

The retailers incur no other costs than the costs of buying the goods. Supply contracts between upstream and downstream firms are determined by bargaining and involve lump

5 Our analysis is also relevant for the case where average costs are U-shaped. We discuss this issue in footnote [12].

6 For example, we can think of retailers operating in different geographic markets.

sum transfers that do not impact product market outcomes. This means that firms use efficient contracts and double marginalization does not occur. We follow other authors[7] studying the effects of integration in a bargaining framework and adopt the Shapley value as a solution concept of the bargaining game.

The Shapley value allocates to each independently negotiating party its expected marginal contribution to coalitions, where the expectation is taken over all coalitions in which the party may belong, with all coalitions assumed to occur with equal probability. Formally, let Ψ denote the set of independently negotiating parties and $|\Psi|$ the cardinality of this set. The payoff of firm $\psi \in \Psi$ is given by

$$U_{\psi}^{\Psi} = \sum_{\widetilde{\Psi} \subseteq \Psi \ | \ \psi \in \widetilde{\Psi}} \frac{\left(\left|\widetilde{\Psi}\right| - 1\right)! \left(|\Psi| - \left|\widetilde{\Psi}\right|\right)!}{|\Psi|!} \left[W_{\widetilde{\Psi}} - W_{\widetilde{\Psi} \setminus \psi}\right], \tag{1}$$

where $\widetilde{\Psi} \subseteq \Psi \mid \psi \in \widetilde{\Psi}$ represents a set $\widetilde{\Psi} \subseteq \Psi$, such that ψ is a member of coalition $\widetilde{\Psi}$ and $W_{\widetilde{\Psi}}$ denotes the maximum surplus achieved by the firms in coalition $\widetilde{\Psi}$. For simplicity, we write $\widetilde{\Psi}\setminus\psi$ for $\widetilde{\Psi}\setminus\{\psi\}$. The maximum industry profit is given by

$$\begin{aligned} W_{\Omega}(\{q_{sr}\}_{sr \in S^0 \times R^0}) = & \sum_{r \in R^0} [p_{Ar}(q_{Ar}, q_{Br})q_{Ar} + p_{Br}(q_{Br}, q_{Ar})q_{Br}] \\ & - \sum_{s \in S^0} C_s(q_{sa} + q_{sb}). \end{aligned}$$

The maximum surplus of a coalition follows from the maximum industry profit by considering only the links between members of the coalition. For example, the coalition $\Omega\setminus A$ does not include supplier A and, hence, the links between A and the two retailers are missing. This means that supplier A cannot provide the retailers with inputs ($q_{Aa} = q_{Ab} = 0$). Analogously, the coalition $\Omega\setminus a$ has no links with retailer a and, hence, this retailer has no access to inputs, i.e., $q_{Aa} = q_{Ba} = 0$.

In the terminology of cooperative game theory, $W(\cdot)$ is often referred to as the *characteristic function*. W_{Ψ} is assumed to be continuous, strictly quasi-concave for all $\Psi \subseteq \Omega$ and superadditive,[8] i.e., $W_{\Psi} \geq W_{\widetilde{\Psi}}$ for every Ψ and $\widetilde{\Psi}$ with $\widetilde{\Psi} \subset \Psi \subseteq \Omega$. Importantly, because at least one supplier and retailer is necessary for production, $W_{\Psi} = 0$ if Ψ does not contain at least one firm from each market side.

The Shapley value corresponds to the idea that in bargaining, a party should reap its marginal contribution to an existing agreement between other parties. However, the marginal contribution of a firm depends on the agreements already in place between other firms.

7 Examples include Hart and Moore (1990); Stole and Zwiebel (1996); Rajan and Zingales (1998); Inderst and Wey (2003); Segal (2003); De Fontenay and Gans (2005b); Montez (2007) and Kranton and Minehart (2000). While the Shapley value is an axiomatic solution concept, there are numerous justifications for the Shapley value as an outcome of a non-cooperative bargaining processes (see, e.g., Gul 1989; Stole and Zwiebel 1996; Inderst and Wey 2003; De Fontenay and Gans 2005a,b and Winter 2002 for a survey).

8 Superadditivity means that the marginal contribution of an arbitrary firm to an arbitrary coalition is non-negative. To ensure that this assumption is met we assume that downstream markets are independent and contracts are efficient. In principle, one could choose less restrictive assumptions. For instance, if retailers were sufficiently differentiated, this assumption would also hold in the presence of downstream competition.

In a well-known interpretation of the Shapley value, players are randomly ordered in a sequence. Because several random orderings are possible, each of them is assumed to be equally likely. Each player gets as a payoff its marginal contribution to the coalition formed by the preceding players in the sequence. The Shapley value is the expected payoff taken over all possible orderings.[9]

To see why this interpretation applies to formula (1), we can split (1) into three components. The first component is the sum operator that iterates over all possible coalitions to which firm ψ may marginally contribute. The third expression—the expression in brackets—is the marginal contribution of firm ψ, i.e., the difference in industry profits with and without firm ψ. Finally, the second component is the fraction and needs more attention.

The fraction may seem to be complicated at first glance, but it has a relatively simple interpretation. First, it is important to note that, in mathematics, the factorial of a set can be used to denote the number of possible orderings. This means that if a set contains n players, there are $n!$ different ways to order them. In the context of the Shapley value, the different orderings describe which party joins the coalition in which position. Because we focus on the coalitions to which firm ψ contributes marginally, we know that firm ψ comes last. The remaining $|\Psi| - 1$ firms in the coalition can be ordered in $(|\Psi| - 1)!$ ways. Similarly, the second part of the numerator describes the number of orderings of the parties outside of the coalition. Taken together, the numerator describes the number of orderings in which a fixed set of firms enters a coalition, with firm ψ entering last. By dividing this expression by the number of all orderings and assuming that all orderings occur with the same probability, we get the likelihood of such an event.

Before we turn to the analysis, we introduce the symmetry assumption that we use in some parts of our analysis to derive clear-cut results. Note that the assumption is not necessary for all results and will be explicitly invoked at various segments of the text.

Assumption 1 [*Symmetry*]. Suppliers and retailers are symmetric: $C_s(\cdot) = C_{s'}(\cdot) = C(\cdot)$, $q_{sr} = q_{s'r'}$ and $p_{sr}(\cdot) = p_{s'r'}(\cdot)$ for any $s, s' \in S^0$ and any $r, r' \in R^0$.

3. Vertical merger incentives

The first part of our analysis is concerned with the derivation of the vertical merger incentives. For this purpose, it is important to be clear about what we mean by a merger. Throughout this paper, we consider a merger as combining two otherwise independent bargaining units into a single firm. Whereas under non-integration each supplier and retailer bargains separately, under integration, the negotiations of the merged entity are controlled by one common agent, which reduces the number of negotiating parties by one. This is a realistic way to think about mergers in which the merged firms are united under a common management, which conducts negotiations with other entities. It would happen, for example, if the key executives of the acquired company were replaced by the new owner.[10]

9 We provide an example in appendix A2.

10 Note that this definition differs from the one in De Fontenay and Gans (2005b). They follow the property rights literature (Grossman and Hart, 1986; Hart and Moore, 1990) and distinguish between the owner and the manager of a firm. After a merger, the manager of a purchased entity remains indispensable in further negotiations and acts as an independent negotiating party.

We can now calculate equilibrium payoffs under different market structures. We use the notation $\{s, s', r, r'\}$ to denote a market structure, where the commas separate non-merged and therefore individually negotiating entities. For example, $\{AB, a, b\}$ stands for the market structure with an upstream monopoly facing a duopoly of retailers. Similarly, $\{Aa, B, b\}$ denotes the market structure consisting of supplier A being vertically integrated with retailer a and supplier B as well as retailer b negotiating independently. For each market structure, the profits of the negotiating parties are immediately given by the Shapley value. Appendix A3 provides an overview of all payoffs under the market structures that are relevant for our analysis. By comparing pre- to post-merger payoffs, we can then derive the vertical integration incentives for various pre-merger market structures.

PROPOSITION 1. *Whether a vertical merger between supplier s and retailer r increases their joint payoff depends on the pre-merger market structure in the following way:*

(i) If suppliers are integrated and retailers are separated ($\Psi = \{AB, a, b\}$), *the joint profit of supplier AB and retailer r weakly increases by vertically merging if* $W_{\Omega \setminus r} + W_{\Omega \setminus r'} \geq W_{\Omega}$, *whereas it decreases if the opposite holds.*
(ii) If suppliers are separated and retailers are integrated ($\Psi = \{A, B, ab\}$), *the joint profit of supplier s and retailer ab weakly increases by vertically merging if* $W_{\Omega \setminus s} + W_{\Omega \setminus s'} \geq W_{\Omega}$, *whereas it decreases if the opposite holds.*
(iii) If suppliers and retailers are non-integrated ($\Psi = \{A, B, a, b\}$), *the joint profit of supplier s and retailer r weakly increases by vertically merging if*

$$\left(W_{\Omega \setminus s'r'} - W_{\Omega \setminus sr}\right) + W_{\Omega \setminus s} + W_{\Omega \setminus r} \geq W_{\Omega}, \tag{2}$$

whereas it decreases if the opposite holds.

In order to give an economic interpretation for proposition 1, the following corollary connects the conditions stated in proposition 1 with the economic fundamentals.

COROLLARY 1. *Vertical merger incentives depend on the initial market structure, the degree of substitutability or complementarity between the final goods and the shape of the unit cost function in the following way:*

(i) With suppliers integrated and retailers separated ($\Psi = \{AB, a, b\}$), *a vertical merger between supplier AB and retailer r takes place (does not take place) if both suppliers have strictly increasing (decreasing) unit costs.*
(ii) With suppliers separated and retailers integrated ($\Psi = \{A, B, ab\}$), *a vertical merger between supplier s and retailer ab takes place (does not take place) if the final goods are strict substitutes (complements).*
(iii) Invoke assumption 1 (symmetry) and take the scenario with all firms separated ($\Psi = \{A, B, a, b\}$). *Supplier s and retailer r merge (stay separated) if* $\Delta_p < \Delta_C$ ($\Delta_p > 0$ *and* $\Delta_C < 0$).

We now provide some intuition on vertical merger incentives. First take the pre-merger case of a monopolist retailer (downstream) facing separated suppliers upstream. In this situation, vertical integration between the retailer and one supplier is profitable for the merging parties if the final goods are substitutes. Why is this so? It is convenient to focus on the effects of integration on the non-merged supplier: because only the distribution of payoffs is affected, not overall output, any gains of the merging parties must correspond exactly to the losses of the non-merged supplier.

If final goods are substitutes, each supplier wants to be the first to reach an agreement with the retailer. This is because the bargaining between a supplier and the retailer revolves around the sharing of the marginal rent generated by the negotiating parties: with final goods being substitutes, the additional rent generated by the first supplier to reach an agreement with the retailer is larger than that generated by the second supplier. Therefore, suppliers prefer negotiating over infra-marginal input quantities to bargaining "on the margin." This explains why, with substitutes, the non-merging supplier loses if the other market actors integrate vertically.

With vertical integration between the retailer and the rival upstream firm, the non-merging supplier cannot be the first to reach an agreement with the retailer, because vertical integration guarantees that an agreement between the rival and the retailer is in place. The non-merging supplier is left with having to bargain at the margin over the lower surplus it generates by coming second to the retailer.

The same logic holds if final goods are complements. In that case, each supplier prefers to be the second in reaching an agreement with the retailer: complementary final goods imply that the additional surplus generated by the second supplier to reach an agreement with the retailer is larger than that generated by the first one, because adding a complement to the market boosts demand for *both* final goods. Vertical integration with complements would ensure that the integrated supplier cannot be the second to reach an agreement with the integrated retailer. This would benefit the non-merging party and therefore harm the firms considering integration.

Take now the situation in which a monopoly supplier negotiates pre-merger with two retailers. Vertical integration between the supplier and a retailer takes place if unit costs are strictly increasing. The reasoning is as follows: if unit costs are strictly increasing, each retailer prefers to be the first to reach an agreement with the supplier, i.e., to negotiate over infra-marginal input quantities. The retailer coming second faces higher unit costs and is therefore left with a smaller surplus over which to negotiate with the supplier. Vertical integration corresponds to a sure agreement between the integrated upstream and downstream firms, leaving the non-merging retailer with being the second as the only option. This erodes the bargaining power of the second retailer and therefore benefits the merging parties.

If unit costs are strictly decreasing, each retailer prefers to be the second to reach an agreement with the supplier and to negotiate for the marginal input quantities. Once a supplier−retailer agreement is in place, the additional rent generated by another retailer is larger because unit costs decrease with the input quantity needed to supply that retailer. In this case, a vertical merger is not attractive because it forces the integrated retailer to be the first.[11,12]

Finally, we explain the intuition behind vertical integration incentives under pre-merger full separation. We focus on the most instructive case, namely when all firms are symmetric

11 An interesting question is whether an integrated firm could commit to not supplying its own retail entity until an agreement with another retailer is in place. We are not aware of such a practice in the context of bargaining.

12 The mechanisms of our analysis also apply to the case where average costs are U-shaped. The vertical merger incentive is driven by a comparison of unit costs at a high output level, where all downstream firms are served, and at a low output level, where only one downstream firm is served. When average costs are U-shaped, its functional form needs to be known in order to make such a comparison. If unit costs are smaller at the low output level than at the high output level, a downstream rival is harmed by vertical integration. If the opposite holds, the rival benefits.

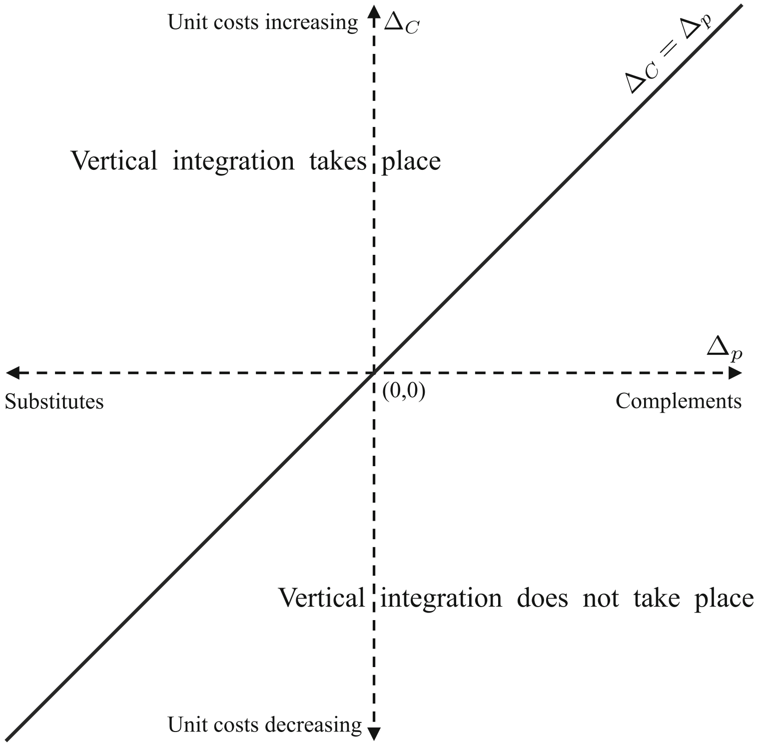

FIGURE 1 Vertical integration incentives

as assumed in corollary 1, and postpone discussing the role of asymmetry to later. Under such circumstances, vertical merger incentives correspond to a mix of vertical integration incentives under an upstream and downstream monopoly. These incentives can point in different directions. Whether incentives for vertical integration arise therefore depends on the relative strength of these forces.

With all firms initially separated, whether a vertical merger is profitable or not depends on the degree of complementarity or substitutability of the final goods compared to how strong unit costs increase or decrease. This relationship is illustrated in figure 1. The strength of complementarity and substitutability is captured by Δ_p while the extent to which unit costs increase or decrease is measured by Δ_C.

A vertical merger implies that the integrated firms are always the first to reach an agreement with each other. If this is what they would want in the absence of the merger, integration is unambiguously profitable. This is the case when final goods are substitutes ($\Delta_p < 0$) and unit costs are increasing ($\Delta_C > 0$). If unit costs are increasing, retailers want to be the first to reach an agreement with each supplier. Being the second means having to negotiate for a lower surplus because unit costs are higher for the additional input quantity to be supplied. If final goods are substitutes, suppliers prefer to be the first to reach an agreement with each retailer. The supplier that comes second must take into account the negative price externality it is imposing on the other final good and, hence, is left to negotiate for a lower surplus. In summary, with substitutes and strictly increasing unit costs, both retailers and suppliers prefer to be the first to reach an agreement with firms on the other market side. This is exactly what a vertical merger guarantees and is therefore unambiguously profitable.

The logic is the same for why vertical mergers are not preferred if final goods are complements ($\Delta_p > 0$) and unit costs are strictly decreasing ($\Delta_C < 0$). Under such circumstances, both retailers and suppliers prefer to be the second to reach an agreement with firms on the other market side, because that is when their marginal contribution is largest. A vertical merger undermines this opportunity because it guarantees being the first to reach an agreement and is therefore unprofitable with no ambiguity.

Interesting situations arise when final goods are substitutes (complements) and unit costs are strictly decreasing (increasing). In these cases, the interests of the suppliers and retailers are not aligned. For example, with substitutes and strictly decreasing unit costs, suppliers prefer to be the first to reach an agreement with each retailer, whereas retailers want to be the second. Because vertical integration implies that the merging parties are always the first to reach an agreement with each other, it benefits the merging supplier but harms the merging retailer. The profitability of such a merger therefore depends on whether the gains of the former exceed the losses of the latter. This is the case if final goods are sufficiently strong substitutes while unit costs are sufficiently slowly decreasing. The same logic applies in reverse if final goods are complements and unit costs are strictly increasing.

In the discussion about vertical integration incentives under pre-merger full separation, we remained silent on the role of asymmetries between firms. We address this issue now. While all of what has been said so far stays valid, asymmetries between firms have some implications for vertical merger incentives. According to claim (iii) of proposition 1, vertical integration between supplier s and retailer r is profitable if

$$\left(W_{\Omega\setminus s'r'} - W_{\Omega\setminus sr}\right) + W_{\Omega\setminus s} + W_{\Omega\setminus r} \geq W_{\Omega}. \tag{3}$$

Under symmetry, the term in brackets cancels out, but not under asymmetry. Expression (3) implies that vertical integration is more likely to take place if the vertically integrated firm is relatively large compared to the non-merging ones (i.e., if the difference $W_{\Omega\setminus s'r'} - W_{\Omega\setminus sr}$ is large). This is the case if the vertically integrated firms s and r are able to produce a relatively large surplus on their own compared to the surplus produced by the non-merging firms s' and r', which rely solely on each other. This is more likely if final goods are substitutes and unit costs are increasing.[13] While the thresholds for vertical integration to take place depicted in figure 1 may shift to the northwest, the qualitative result behind figure 1 remains intact: vertical integration incentives are stronger when unit costs increase fast and final goods are stronger substitutes.

Finally, it remains to note that in our set-up, vertical integration incentives are not unambiguously larger under upstream competition than under monopoly. This is especially true in the case of substitutes and strictly increasing unit costs. Therefore, our findings are in contrast to the results derived by De Fontenay and Gans (2005b), who find that vertical integration incentives are always stronger with upstream competition in the aforementioned case. To see this, we can compare the conditions for vertical integration under both market structures as given in claims (i) and (iii) of proposition 1.

Vertical integration incentives are stronger under upstream monopoly than under competition if

$$W_{\Omega\setminus r} + W_{\Omega\setminus r'} > \left(W_{\Omega\setminus s'r'} - W_{\Omega\setminus sr}\right) + W_{\Omega\setminus s} + W_{\Omega\setminus r}, \tag{4}$$

whereas they are weaker if the opposite holds. To demonstrate that arrangements exist in which vertical integration incentives under an upstream monopoly are stronger than under

13 This is the combination when inframarginal surplus is the largest. The merged firm is guaranteed this inframarginal surplus without negotiation.

competition, we focus on the case of symmetry. Then, condition (4) reduces to $W_{\Omega\setminus r} > W_{\Omega\setminus s}$, which holds if an additional retailer increases total surplus by a relatively small amount, while the marginal contribution of a supplier is rather large. This is likely to be the case, for example, if unit costs are strongly increasing while final goods are relatively weak substitutes (or even complements). Upstream competition can therefore either enhance or reduce the incentives for vertical integration.

4. Comparing vertical and horizontal merger incentives

In this section, we compare vertical and horizontal merger incentives based purely on bargaining power considerations. Throughout this section, we invoke assumption 1 (symmetry) to obtain clear-cut results.

We proceed in three steps. We first explain horizontal merger incentives. Because in this case our model corresponds to Inderst and Wey (2003), we summarize their results on horizontal integration and then explain why vertical merger incentives are a combination of upstream and downstream merger incentives. Second, we compare the gains from horizontal and vertical mergers. Third, we analyze a bidding game where upstream and downstream firms bid for an exogenously picked target firm (either a supplier or a retailer).

4.1. Horizontal mergers

Inderst and Wey (2003) derive conditions under which horizontal mergers are profitable from the perspective of bargaining power. Adapting corollary 1 of Inderst and Wey (2003), retailers merge if

$$W_{\Omega\setminus a} + W_{\Omega\setminus b} > W_{\Omega}, \tag{5}$$

whereas they stay separated if the inequality is reversed. Similarly, suppliers merge if

$$W_{\Omega\setminus A} + W_{\Omega\setminus B} > W_{\Omega}, \tag{6}$$

and they stay separated if the opposite holds.

This implies that upstream firms merge (stay separated) if final goods are strict substitutes (complements), while downstream firms merge (stay separated) if upstream firms have strictly increasing (decreasing) unit costs (proposition 2 of Inderst and Wey, 2003). It should be noted that merger incentives on each market side are independent of whether firms are merged or not on the other side.

Because vertical merger incentives are affected by the same economic determinants, we conclude that they can be regarded as a combination of horizontal integration incentives upstream and downstream. The intuition behind this result is as follows. Depending on the substitutability or complementarity as well as the shape of the unit cost function, firms on each market side want to finish their negotiations with firms on the other market side either first or second. A horizontal merger ensures an agreement with both firms on the other market side, because the merged entity becomes a monopolist and is therefore indispensable. A vertical merger ensures an agreement with only one firm on the other side of the market. However, contrary to a horizontal merger, a vertical merger involves firms from both market sides, so that there is a coexistence of integration incentives upstream and downstream.

4.2. Comparison of horizontal and vertical merger gains

We turn to the comparison of horizontal and vertical merger gains and define the gain of a merger Δ_x, $x \in \{U, D, V\}$ as the difference in the joint pre- and post-merger profits of the merging firms. The subscript U refers to an upstream merger, D to a downstream merger and V to a vertical merger:

$$\begin{aligned}
\Delta_U &= U_{AB}^{\{AB,a,b\}} - U_A^{\{A,B,a,b\}} - U_B^{\{A,B,a,b\}},\\
\Delta_D &= U_{ab}^{\{A,B,ab\}} - U_a^{\{A,B,a,b\}} - U_b^{\{A,B,a,b\}},\\
\Delta_V &= U_{Aa}^{\{Aa,B,b\}} - U_A^{\{A,B,a,b\}} - U_a^{\{A,B,a,b\}}.
\end{aligned}$$

Note that we added a superscript to the payoff U_i in order to distinguish between the different market structures under which payoffs are computed. Moreover, we focus on a vertical merger between supplier A and retailer a because firms on both market sides are symmetric.

The result that vertical merger incentives are a combination of upstream and downstream incentives leads directly to a conclusion about the ordering of merger gains. Vertical merger incentives consist equally of upstream and downstream horizontal merger incentives. However, each horizontal merger incentive enters at only half strength because only one firm is directly affected. As long as horizontal merger incentives upstream and downstream are not equally strong, vertical integration incentives must be strictly between the upstream and downstream merger incentives.[14] Proposition 2 summarizes this conclusion.

PROPOSITION 2. *The gains from horizontal upstream, horizontal downstream and vertical mergers are ordered as follows:*

$$\Delta_U \gtrless \Delta_V \gtrless \Delta_D \quad \Leftrightarrow \quad W_{\Omega\setminus s} \gtrless W_{\Omega\setminus r}.$$

The following corollary links the condition $W_{\Omega\setminus s} \gtrless W_{\Omega\setminus r}$ to the primitives of our model.

COROLLARY 2. *The following implications hold for all $s \in S^0$ and $r \in R^0$:*

$$\begin{aligned}
-\Delta_p < \Delta_C \quad &\Rightarrow \quad W_{\Omega\setminus s} < W_{\Omega\setminus r},\\
-\Delta_p > \Delta_C \quad &\Rightarrow \quad W_{\Omega\setminus s} > W_{\Omega\setminus r}.
\end{aligned}$$

If final goods are substitutes ($\Delta_p < 0$) and unit costs are decreasing ($\Delta_C < 0$), suppliers want to merge, while retailers want to stay separated. In other words, the gain of a horizontal upstream merger is positive, while the gain of a downstream merger is negative. Thus, the incentive for the suppliers to merge is the strongest and the incentive for the retailers is the weakest. Analogously, the order is reversed if final goods are complements ($\Delta_p > 0$) and unit costs are increasing ($\Delta_C > 0$).

In the case of substitutes ($\Delta_p < 0$) and strictly increasing unit costs ($\Delta_C > 0$), the gains of both horizontal upstream and downstream mergers are positive, such that the ratio of the strengths of both integration incentives determines the ordering. This is similar to the case of complements ($\Delta_p > 0$) and strictly decreasing unit costs ($\Delta_C < 0$) in which both merger gains are negative.

4.3. Bidding game

Can bargaining incentives drive horizontal and vertical mergers to prevent a takeover by others? And which firm can be expected to prevail in a takeover auction? We investigate

14 In the special case of equally strong horizontal merger incentives, vertical incentives will be equal as well, and firms are indifferent between all types of mergers.

these questions in a bidding game, where a single firm is up for sale to the highest bidder in the industry. Bidders evaluate their gain from winning the auction against the possible outcomes when not winning the auction. In the latter case, the counterfactual becomes another firm potentially taking over the target. This has implications for bidding incentives.

We assume that one firm, either upstream or downstream, is up for sale. This firm will be referred to as the target firm. The other firms in the market bid to acquire the target, which is sold to the highest bidder. We also consider the existence of an outside option, i.e., the target firm will be sold only if the highest bid exceeds its profit under full separation. We will refer to this minimum bid level as the reservation price. Each possible buyer has a maximum willingness-to-pay (hereafter referred to as WTP), which consists of two parts. The first part is the gain that a buyer realizes because of the merger, whereas the second part is given by the loss if a competitor merges instead.

Horizontal integration incentives are said to be stronger (weaker) than vertical integration incentives if the bidder on the same market side as the target has a higher (lower) WTP to merge with the target than all bidders from the other market side.

The auction is modelled as a two-stage game, with firms submitting sealed bids for the target in the first stage. At the end of the stage, the firm with the highest bid merges with the target if the bid exceeds the reservation price. In the second stage, the acquirer pays out its bid and supply contracts are negotiated. We solve the game using backward induction and can start immediately with the first stage because second-stage profits are determined by the Shapley value.

We first turn to the case where a supplier is the target and assume without loss of generality that firm A is up for sale. Firms B and a submit bids β_B and β_a, respectively:

$$\beta_B = \begin{cases} U_{AB}^{\{AB,a,b\}} - U_B^{\{A,B,a,b\}} & \text{if } \beta_a < U_A^{\{A,B,a,b\}} \\ U_{AB}^{\{AB,a,b\}} - U_B^{\{A,B,a,b\}} + U_B^{\{A,B,a,b\}} - U_B^{\{Aa,B,b\}} & \text{if } \beta_a > U_A^{\{A,B,a,b\}}. \end{cases} \tag{7}$$

$$\beta_a = \begin{cases} U_{Aa}^{\{Aa,B,b\}} - U_a^{\{A,B,a,b\}} & \text{if } \beta_B < U_A^{\{A,B,a,b\}} \\ U_{Aa}^{\{Aa,B,b\}} - U_a^{\{A,B,a,b\}} + U_a^{\{A,B,a,b\}} - U_a^{\{AB,a,b\}} & \text{if } \beta_B > U_A^{\{A,B,a,b\}}. \end{cases} \tag{8}$$

The case distinction accounts for the fact that a merger with a competitor is not necessarily a credible threat if the bidder itself refuses to merge. A takeover by a rival constitutes a credible threat only if the WTP of the competitor exceeds the reservation price of the target. Otherwise, the target is not sold and the distribution of bargaining rents remains unaffected. Consequently, under such circumstances, the bidder's bargaining position remains unaffected in case of non-merging and its WTP equals its bargaining gain in case of merging.

Equations (7) and (8) can be rewritten in terms of the industry profit as derived in appendix A3. On this basis, we have to check for each ordering of bids β_B, β_a and $U_A^{\{A,B,a,b\}}$ whether the bids actually exceed the target firm's reservation price so that the sale of the target actually takes place. For example, consider the case

$$\beta_B < \beta_a < U_A^{\{A,B,a,b\}}.$$

In this case, the target firm has a higher reservation price than the bids, and consequently remains unsold. The WTP of firms B and a reduces to

$$\beta_B = \frac{1}{12}\left[2\, W_{\Omega\backslash a} + 2\, W_{\Omega\backslash A} + W_\Omega\right] \quad \text{and} \quad \beta_a = \frac{1}{12}\left[4\, W_{\Omega\backslash a} + W_\Omega\right].$$

We can then derive the conditions under which various orderings of bids occur as follows:

$$\begin{aligned} \beta_B < \beta_a \quad &\Leftrightarrow \quad W_{\Omega\backslash A} < W_{\Omega\backslash a}, \\ \beta_B < U_A^{\{A,B,a,b\}} \quad &\Leftrightarrow \quad W_\Omega < 2W_{\Omega\backslash A}, \\ \beta_a < U_A^{\{A,B,a,b\}} \quad &\Leftrightarrow \quad W_\Omega < W_{\Omega\backslash A} + W_{\Omega\backslash a}. \end{aligned}$$

The computations in all other cases are straightforward and can be found in the proof of proposition 3, which summarizes the results.

We turn to the case where a retailer is up for sale and assume without loss of generality that firm a is the target. Supplier A and retailer b submit bids β_A and β_b, respectively:

$$\beta_A = \begin{cases} U_{Aa}^{\{Aa,B,b\}} - U_A^{\{A,B,a,b\}} & \text{if } \beta_b < U_a^{\{A,B,a,b\}} \\ U_{Aa}^{\{Aa,B,b\}} - U_A^{\{A,B,a,b\}} + U_A^{\{A,B,a,b\}} - U_A^{\{A,B,ab\}} & \text{if } \beta_b > U_a^{\{A,B,a,b\}}, \end{cases} \tag{9}$$

$$\beta_b = \begin{cases} U_{ab}^{\{A,B,ab\}} - U_b^{\{A,B,a,b\}} & \text{if } \beta_A < U_a^{\{A,B,a,b\}} \\ U_{ab}^{\{A,B,ab\}} - U_b^{\{A,B,a,b\}} + U_b^{\{A,B,a,b\}} - U_b^{\{Aa,B,b\}} & \text{if } \beta_A > U_a^{\{A,B,a,b\}}. \end{cases} \tag{10}$$

As before, these relationships can be rewritten using appendix A3 and the conditions under which each firm prevails can be derived for all possible orderings of bids β_A, β_b and the target's reservation price $U_a^{\{A,B,a,b\}}$. The following proposition sums up our main result from this analysis:

PROPOSITION 3. *The outcome of the auction is independent of whether a supplier or a retailer is up for sale. If, in all possible merger constellations, the joint profit of the merging firms is lower than their joint profit under full separation, no merger takes place. Otherwise, a retailer completes the takeover if* $W_{\Omega\backslash a} > W_{\Omega\backslash A}$*, whereas a supplier acquires the target firm if* $W_{\Omega\backslash a} < W_{\Omega\backslash A}$.

The result that the target firm is not sold if neither vertical nor horizontal mergers with the target are profitable can be explained as follows. In our model, changes in bargaining power affect only the distribution of rents. If a merger is unprofitable, the merged firms face a loss compared to their joint profit under full separation and, hence, the non-integrated firms benefit. Consequently, firms never have an incentive to prevent an unprofitable merger of their competitors and will bid less than the reservation price in order to stay separated.

In the remaining cases, a firm from the market side on which the competitive pressure is largest completes the takeover. To see this, note that the case of strictly decreasing unit costs and complements is excluded because no merger occurs in this case. Thus, on at least one market side, firms have an incentive to finish negotiations first so that they are not affected by a negative externality because of substitutability or strictly increasing unit costs. An increase in the strength of the externality has two effects. On the one hand, the contribution of the firm signing a contract second decreases, i.e., $W_{\Omega\backslash A}$ or $W_{\Omega\backslash a}$ increases. On the other hand, there is an increase in the incentive to conclude negotiations first as this can be considered as an indicator of the competitive pressure. Therefore, the question of which firm completes the takeover can be translated into a comparison of the competitive pressures on both market sides.

Further insights can be derived by comparing proposition 2 and proposition 3.

Corollary 3. *Consider the cases in which a merger takes place. The firm with the largest gain in profits due to the merger with the target firm completes the takeover.*

As shown in proposition 2, the gain of a vertical merger is always in between the gains of both types of horizontal mergers. If, as corollary 3 states, the bidder with the highest gain acquires the target firm, how can a vertical merger occur? The striking difference between our auction model and the simple comparison of merger gains is that the auction does not allow for horizontal mergers on the other market side than that of the target firm. Therefore, a vertical merger is the best way to realize the merger incentives of the other market side. To put it simply, vertical mergers are driven by the merger incentives of the other market side.

The second striking difference is that firms take into account the other market participants as bidders. The idea is that firms might acquire the target firm in order to pre-empt a merger with another bidder. If, like in our model, the firm with the highest gain in profits completes the acquisition, pre-emption is never the determining factor for the decision.[15] We conclude:

Corollary 4. *Firms never acquire the target firm in order to pre-empt the merger of another market participant.*

Corollary 4 shows that bargaining power considerations neither strengthen nor weaken pre-emption decisions. The intuition is the following: changes in bargaining power, ceteris paribus, lead to a change in the distribution of rents, but the total surplus generated remains unaffected. Thus, if a merger is profitable, the loss of the non-integrated firms is equal to the gain of the merged firms. Consequently, the loss of a single non-integrated competitor is (weakly) smaller than the gain of the integrated firm and, hence, the incentive to prevent the merger is (weakly) smaller than the incentive of the other firms to carry out the merger.

Finally, we briefly address counter-mergers. The idea is that the remaining non-integrated parties may want to merge to counteract possible negative effects caused by the merger of their competitors. Take the case of a horizontal merger with the target firm. As shown by Inderst and Wey (2003) (proposition 2), horizontal merger incentives on each market side are not affected by whether firms are merged or not on the other market level. Thus, a horizontal counter-merger takes place if the target firm is a supplier and unit costs are strictly increasing or if the target is a retailer and final goods are substitutes.

Now turn to the case of a vertical merger with the target firm and keep in mind that, in our model, mergers affect only the distribution of rents. As shown in proposition 3, a vertical merger takes place only if it is profitable, i.e., the joint profit of the merged firms increases compared to the case of full separation. This means, in turn, that the joint profit of the non-merging firms decreases. A vertical counter-merger leads to two symmetric vertically integrated firms, so that the surplus is shared equally. A counter-merger, therefore, always takes place because this leads to an increase in the joint profit of the non-integrated firms to pre-auction level.

15 Our result differs from Colangelo (1995), which shows that vertical mergers can be driven by the incentive to prevent a horizontal merger. However, his model is not tailored to the analysis of bargaining power, but merger decisions are affected by the monopolization of the downstream market, the elimination of double markups and price discrimination against non-integrated firms.

5. Conclusion

We propose a model of a bilaterally duopolistic industry where upstream producers bargain with downstream retailers over supply conditions. In the applied framework, integration does not affect the total output produced, but it does affect the distribution of rents among players. We make four contributions in this article.

First, we identify conditions for vertical mergers to occur and show that vertical integration incentives can be regarded as a combination of horizontal merger incentives upstream and downstream. Second, we directly compare the strength of horizontal and vertical merger incentives and find that vertical merger incentives always fall between upstream and downstream horizontal merger incentives. Third, we show that a horizontal merger to monopoly may convey less bargaining power to the merged entity than vertical integration. Fourth, we find that a vertical merger is never motivated by pre-emptive bargaining power considerations.

While many of our results are general, this article has some limitations. Our analysis focuses on the pure bargaining effects of mergers, taking product market outcomes as constant. In particular, we assume that there are no competitive externalities downstream and that contracts in the input market are efficient. This allows us to identify the main forces behind bargaining, in isolation of price and efficiency considerations. These considerations outside our model, however, must remain an integral part of merger analysis. As for the absence of downstream competition, we offer an alternative approach in our online appendix that allows us to relax this assumption. However, both our model and the model used in the online appendix are not able to include other contractual relationships that could, for example, lead to a double markup problem, thereby ignoring potential efficiency incentives for vertical integration.

While the aforementioned assumptions allow the application of the Shapley value, it is worth noting that empirical applications of bargaining models often use an alternative concept, the so-called Nash-in-Nash bargaining (see Collard-Wexler et al. 2019 for a micro-foundation and the references given there for examples). We can show that the outcomes of our analysis differ if we use Nash-in-Nash bargaining in combination with passive beliefs. More precisely, if we assume that production decisions and bargaining are made simultaneously, vertical integration does not have any effect on firm profits. If, however, the integrated firm is allowed to adjust its production decision with respect to its own integrated retailer, vertical integration is always profitable. This is because the integrated firm can better respond to a bargaining breakdown, which shifts its threat point in negotiations with non-integrated firms.

This means that under Nash-in-Nash bargaining and passive beliefs, the ability of firms to condition decisions on changes in the market structure due to bargaining breakdowns benefits firms. Here, the benefits of the Shapley value come into play. In the model of Inderst and Wey (2003), the Shapley value is derived from, among others, the assumption that firms use contingent contracts, i.e., firms can specify contracts contingent on the market structure. This is a simplified mechanism that allows firms to respond to off-equilibrium events like bargaining breakdowns. In contrast to Nash-in-Nash bargaining with passive beliefs, it allows all firms, not just the integrated firm, to adjust their decisions, which can be interpreted as the possibility for firms to renegotiate contracts in the case of long-lasting blackouts.

The question of which model is preferable remains, and this is generally difficult to answer. On the one hand, it is likely that the possibility to renegotiate contracts in the case of long-lasting blackouts will depend on the industry structure and the institutional environment. On the other hand, even if the researcher has a particular industry in mind, it might be difficult to determine the appropriate model because long-lasting blackouts are off-equilibrium outcomes and therefore rarely observed in practice (see Salop, 2018, for a related discussion in the context of the US pay TV example).

Another restriction in our analysis is the assumption of symmetry for some results. Imposing this assumption helps obtain clear and simple results, at the cost of omitting potential effects from asymmetry between firms. We expect that asymmetry may qualify the strength of various effects identified in our model, but would not turn these around. Uncovering the role of asymmetries in more detail would be an interesting avenue for further research.

Finally, while this article confines itself to the analysis of vertical merger incentives also in comparison to horizontal ones, many possible extensions arise naturally. Extending the bilateral duopoly set-up to more firms as well as taking into account investment incentives could be fruitful topics for further research.

Appendix A1: Proofs

The proofs require the application of the Shapley value. Appendix A3 gives an overview of the profits under various market structures.

Proof of proposition 1. The proof follows immediately by comparing the change in payoffs of the merging parties as summarized in table A1.

TABLE A1
Change in payoffs by vertical integration

Change in market structure	Change in payoffs of vertically merging parties (ΔU)
$\{AB, a, b\}$	$[U_{AB} + U_a]_{\{AB,a,b\}} = \frac{1}{6}\left[4W_\Omega - W_{\Omega\setminus a} + 2W_{\Omega\setminus b}\right]$
$\downarrow$	$[U_{ABa}]_{\{ABa,b\}} = \frac{1}{2}\left[W_{\Omega\setminus b} + W_\Omega\right]$
$\{ABa, b\}$	$\Delta U_{ABa} = \frac{1}{6}\left[W_{\Omega\setminus a} + W_{\Omega\setminus b} - W_\Omega\right]$
$\{A, B, ab\}$	$[U_A + U_{ab}]_{\{A,B,ab\}} = \frac{1}{6}\left[4W_\Omega - W_{\Omega\setminus A} + 2W_{\Omega\setminus B}\right]$
$\downarrow$	$[U_{Aab}]_{\{Aab,B\}} = \frac{1}{2}\left[W_{\Omega\setminus B} + W_\Omega\right]$
$\{Aab, B\}$	$\Delta U_{Aab} = \frac{1}{6}\left[W_{\Omega\setminus A} + W_{\Omega\setminus B} - W_\Omega\right]$
$\{A, B, a, b\}$	$[U_A + U_a]_{\{A,B,a,b\}} = \frac{1}{6}\left[3W_\Omega - W_{\Omega\setminus Aa} + W_{\Omega\setminus Bb} - W_{\Omega\setminus A} + W_{\Omega\setminus B} - W_{\Omega\setminus a} + W_{\Omega\setminus b}\right]$
$\downarrow$	$[U_{Aa}]_{\{Aa,B,b\}} = \frac{1}{6}\left[2W_{\Omega\setminus Bb} + W_{\Omega\setminus b} + W_{\Omega\setminus B} - 2W_{\Omega\setminus Aa} + 2W_\Omega\right]$
$\{Aa, B, b\}$	$\Delta U_{Aa} = \frac{1}{6}\left[\left(W_{\Omega\setminus Bb} - W_{\Omega\setminus Aa}\right) + W_{\Omega\setminus A} + W_{\Omega\setminus a} - W_\Omega\right]$

■

Proof of corollary 1. We proceed by proving each claim separately.

Claim (i). With suppliers integrated and retailers separated ($\Psi = \{AB, a, b\}$), the condition under which a vertical merger between supplier AB and retailer r takes place is given by claim (i) in proposition 1. This is identical to the condition under which a horizontal merger between retailers takes place in Inderst and Wey (2003). The proof of claim (i) follows immediately from corollary 1(ii) and proposition 2 of Inderst and Wey (2003).

Claim (ii). With suppliers separated and retailers integrated ($\Psi = \{A, B, ab\}$), the condition for a vertical merger between supplier s and retailer ab to take place is given by claim (ii) of proposition 1. This is identical to the condition for a horizontal merger between suppliers to take place in Inderst and Wey (2003). The proof of claim (ii) follows immediately from corollary 1(i) and proposition 2 of Inderst and Wey (2003).

Claim (iii). Under assumption 1 (symmetry), the condition for a vertical merger to take place in claim (iii) of proposition 1 reduces to

$$W_{\Omega\setminus s} + W_{\Omega\setminus r} > W_{\Omega}. \tag{A1}$$

We focus without loss of generality on a merger of supplier A with retailer a. The proof for any other supplier-retailer combination would proceed analogously. We first show that a vertical merger takes place if final goods are substitutes and unit costs are strictly increasing. Let q_{sr}^{Ψ} denote the quantity of input s used by retailer r if the subset $\Psi \subseteq \Omega$ of firms participate. Condition (A1) can be written as

$$\begin{aligned}
&\left[\sum_{r\in R^0} p_{Br}\left(q_{Br}^{\Omega\setminus A}, 0\right) q_{Br}^{\Omega\setminus A} - C_B\left(q_{Br}^{\Omega\setminus A} + q_{Br'}^{\Omega\setminus A}\right)\right] \\
&\quad + \left[\sum_{s\in S^0} p_{sb}\left(q_{sb}^{\Omega\setminus a}, q_{s'b}^{\Omega\setminus a}\right) q_{sb}^{\Omega\setminus a} - \sum_{s\in S^0} C_s\left(q_{sb}^{\Omega\setminus a}\right)\right] \\
&\quad > \left[\sum_{s\in S^0}\sum_{r\in R^0} p_{sr}\left(q_{sr}^{\Omega}, q_{s'r}^{\Omega}\right) q_{sr}^{\Omega} - \sum_{s\in S^0} C_s\left(q_{sr}^{\Omega} + q_{sr'}^{\Omega}\right)\right].
\end{aligned} \tag{A2}$$

Note that the sum of payoffs on the LHS in (A1) does not increase if the optimal quantities $q_{rs}^{\Omega\setminus A}$ and $q_{rs}^{\Omega\setminus a}$ are replaced by q_{rs}^{Ω}. It follows that (A1) holds if

$$\begin{aligned}
&\left[\sum_{r\in R^0} p_{Br}\left(q_{Br}^{\Omega}, 0\right) q_{Br}^{\Omega} - C_B\left(q_{Br}^{\Omega} + q_{Br'}^{\Omega}\right)\right] \\
&\quad + \left[\sum_{s\in S^0} p_{sb}\left(q_{sb}^{\Omega}, q_{s'b}^{\Omega}\right) q_{sb}^{\Omega} - \sum_{s\in S^0} C_s\left(q_{sb}^{\Omega}\right)\right] \\
&\quad > \left[\sum_{s\in S^0}\sum_{r\in R^0} p_{sr}\left(q_{sr}^{\Omega}, q_{s'r}^{\Omega}\right) q_{sr}^{\Omega} - \sum_{s\in S^0} C_s\left(q_{sr}^{\Omega} + q_{sr'}^{\Omega}\right)\right].
\end{aligned}$$

Under assumption 1 (symmetry), this inequality can be written as

$$4p\left(q^{\Omega}, q^{\Omega}\right) q^{\Omega} - 2C\left(2q^{\Omega}\right) < 2p\left(q^{\Omega}, 0\right) q^{\Omega} - C\left(2q^{\Omega}\right) + 2p\left(q^{\Omega}, q^{\Omega}\right) q^{\Omega} - 2C\left(q^{\Omega}\right).$$

Dividing by $2q^{\Omega}$ and rearranging yields

$$p\left(q^{\Omega}, q^{\Omega}\right) - p\left(q^{\Omega}, 0\right) < \overline{C}(2q^{\Omega}) - \overline{C}\left(q^{\Omega}\right),$$

or identically, $\Delta_p\left(q^{\Omega}\right) < \Delta_C\left(q^{\Omega}\right)$. The RHS is positive if unit costs are strictly increasing while the LHS is negative if final goods are substitutes. Consequently, if final goods are substitutes and unit costs are strictly increasing, condition (A1) holds.

Next, we show that if final goods are complements and unit costs are strictly decreasing, no vertical merger takes place. A vertical merger does not occur if inequality (A2) is reversed, such that

$$\left[\sum_{r\in R^0} p_{Br}\left(q_{Br}^{\Omega\backslash A},0\right)q_{Br}^{\Omega\backslash A} - C_B\left(q_{Br}^{\Omega\backslash A}+q_{Br'}^{\Omega\backslash A}\right)\right]$$

$$+\left[\sum_{s\in S^0} p_{sb}\left(q_{sb}^{\Omega\backslash a},q_{s'b}^{\Omega\backslash a}\right)q_{sb}^{\Omega\backslash a} - \sum_{s\in S^0} C_s\left(q_{sb}^{\Omega\backslash a}\right)\right]$$

$$<\left[\sum_{s\in S^0}\sum_{r\in R^0} p_{sr}\left(q_{sr}^{\Omega},q_{s'r}^{\Omega}\right)q_{sr}^{\Omega} - \sum_{s\in S^0} C_s\left(q_{sr}^{\Omega}+q_{sr'}^{\Omega}\right)\right].$$

Under assumption 1 (symmetry), this can be written as

$$\left[2p\left(q^{\Omega\backslash A},0\right)q^{\Omega\backslash A} - C\left(2q^{\Omega\backslash A}\right)\right] + \left[2p\left(q^{\Omega\backslash a},q^{\Omega\backslash a}\right)q^{\Omega\backslash a} - 2C\left(q^{\Omega\backslash a}\right)\right]$$

$$< \left[2p\left(q^{\Omega},q^{\Omega}\right)q^{\Omega} - C\left(2q^{\Omega}\right)\right] + \left[2p\left(q^{\Omega},q^{\Omega}\right)q^{\Omega} - C\left(2q^{\Omega}\right)\right].$$

Each bracket on the RHS corresponds to half of the industry surplus if all firms participate. We can replace the optimal quantities on the RHS by other quantities and find that if the new inequality holds, the above inequality with optimal quantities would also hold. In the first bracket, we replace q^{Ω} by $q^{\Omega\backslash A}$ and in the second bracket by $q^{\Omega\backslash a}$. Doing so yields

$$2p\left(q^{\Omega\backslash A},0\right)q^{\Omega\backslash A} - 2C\left(q^{\Omega\backslash a}\right) < 2p\left(q^{\Omega\backslash A},q^{\Omega\backslash A}\right)q^{\Omega\backslash A} - C\left(2q^{\Omega\backslash a}\right).$$

By rearranging and dividing both sides by $2q^{\Omega\backslash a}$, we get

$$\left[p\left(q^{\Omega\backslash A},q^{\Omega\backslash A}\right) - p\left(q^{\Omega\backslash A},0\right)\right]\frac{q^{\Omega\backslash A}}{q^{\Omega\backslash a}} > \overline{C}\left(2q^{\Omega\backslash a}\right) - \overline{C}\left(q^{\Omega\backslash a}\right),$$

which is equivalent to $\Delta_C\left(q^{\Omega\backslash a}\right) < \Delta_p\left(q^{\Omega\backslash A}\right)\frac{q^{\Omega\backslash A}}{q^{\Omega\backslash a}}$. The LHS of this inequality is negative if unit costs are strictly decreasing while the RHS is positive when final goods are complements. We can conclude that if final goods are complements and unit costs are strictly decreasing, no vertical merger between a supplier and a retailer takes place. ■

Proof of proposition 2. We use assumption 1 (symmetry) and consider without loss of generality $s = A$ and $r = a$. Using appendix A3, we rewrite the first inequality as follows:

$$U_{AB}^{\{AB,a,b\}} - U_{A}^{\{A,B,a,b\}} - U_{B}^{\{A,B,a,b\}}$$

$$\lesseqgtr U_{Aa}^{\{Aa,B,b\}} - U_{A}^{\{A,B,a,b\}} - U_{a}^{\{A,B,a,b\}}$$

$$\Leftrightarrow \quad W_{\Omega\backslash B} \lesseqgtr W_{\Omega\backslash Bb} + W_{\Omega\backslash a} - W_{\Omega\backslash Aa}.$$

We apply the symmetry assumption:

$$W_{\Omega\backslash B} \lesseqgtr W_{\Omega\backslash Bb} + W_{\Omega\backslash a} - W_{\Omega\backslash Aa}$$

$$\Leftrightarrow \quad W_{\Omega\backslash B} \lesseqgtr W_{\Omega\backslash a} \quad \Leftrightarrow \quad W_{\Omega\backslash s} \lesseqgtr W_{\Omega\backslash r}.$$

The second inequality can be rewritten in a similar way:

$$\begin{aligned} & U_{ab}^{\{A,B,ab\}} - U_{a}^{\{A,B,a,b\}} - U_{b}^{\{A,B,a,b\}} \\ & \quad \lesseqgtr U_{Aa}^{\{Aa,B,b\}} - U_{A}^{\{A,B,a,b\}} - U_{a}^{\{A,B,a,b\}} \\ \Leftrightarrow \quad & W_{\Omega\setminus b} \lesseqgtr W_{\Omega\setminus Bb} - W_{\Omega\setminus Aa} + W_{\Omega\setminus A} \\ \Leftrightarrow \quad & W_{\Omega\setminus b} \lesseqgtr W_{\Omega\setminus A} \\ \Leftrightarrow \quad & W_{\Omega\setminus r} \lesseqgtr W_{\Omega\setminus s}. \end{aligned}$$

■

Proof of corollary 2. In the following, $\alpha(f)$ denotes the competitor of firm f on the same market side. The inequality $W_{\Omega\setminus r} > W_{\Omega\setminus s}$ can be written as

$$\begin{aligned} & \sum_{s' \in S^0} p_{s'\alpha(r)}\left(q_{s'\alpha(r)}^{\Omega\setminus r}, q_{\alpha(s')\alpha(r)}^{\Omega\setminus r}\right) q_{s'\alpha(r)}^{\Omega\setminus r} - \sum_{s' \in S^0} C_{s'}\left(q_{s'\alpha(r)}^{\Omega\setminus r}\right) \\ & \quad > \sum_{r' \in R^0} p_{\alpha(s)r'}\left(q_{\alpha(s)r'}^{\Omega\setminus s}, 0\right) q_{\alpha(s)r'}^{\Omega\setminus s} - C_{\alpha(s)}\left(q_{\alpha(s)r'}^{\Omega\setminus s} + q_{\alpha(s)\alpha(r')}^{\Omega\setminus s}\right). \end{aligned} \tag{A3}$$

Under assumption 1 (symmetry), the RHS remains unchanged if we replace the quantity $q_{\alpha(s)\alpha(r')}^{\Omega\setminus s}$ by $q_{\alpha(s)r'}^{\Omega\setminus s}$. Furthermore, the LHS does not increase if we replace the quantities by $q_{\alpha(s)r'}^{\Omega\setminus s}$ because the original quantities maximize the expression. We define $q^s := q_{\alpha(s)r'}^{\Omega\setminus s}$. Therefore, inequality (A3) holds if the following inequality is fulfilled:

$$2q^{\Omega\setminus s} \cdot p\left(q^{\Omega\setminus s}, q^{\Omega\setminus s}\right) - 2C\left(q^{\Omega\setminus s}\right) > 2q^{\Omega\setminus s} \cdot p\left(q^{\Omega\setminus s}, 0\right) - C\left(2q^{\Omega\setminus s}\right).$$

Dividing both sides by $2q^{\Omega\setminus s}$ yields

$$p\left(q^{\Omega\setminus s}, q^{\Omega\setminus s}\right) - \overline{C}\left(q^{\Omega\setminus s}\right) > p\left(q^{\Omega\setminus s}, 0\right) - \overline{C}\left(2q^{\Omega\setminus s}\right),$$

which can be rearranged to $-\Delta_p\left(q^{\Omega\setminus s}\right) < \Delta_C\left(q^{\Omega\setminus s}\right)$. As a result, we find that $W_{\Omega\setminus r} > W_{\Omega\setminus s}$ is fulfilled if inequality $-\Delta_p\left(q^{\Omega\setminus s}\right) < \Delta_C\left(q^{\Omega\setminus s}\right)$ holds.

The argument for $W_{\Omega\setminus r} < W_{\Omega\setminus s}$ is analogous. This inequality can be written as

$$\begin{aligned} & \sum_{s' \in S^0} p_{s'\alpha(r)}\left(q_{s'\alpha(r)}^{\Omega\setminus r}, q_{\alpha(s')\alpha(r)}^{\Omega\setminus r}\right) q_{s'\alpha(r)}^{\Omega\setminus r} - \sum_{s' \in S^0} C_{s'}\left(q_{s'\alpha(r)}^{\Omega\setminus r}\right) \\ & \quad < \sum_{r' \in R^0} p_{\alpha(s)r'}\left(q_{\alpha(s)r'}^{\Omega\setminus s}, 0\right) q_{\alpha(s)r'}^{\Omega\setminus s} - C_{\alpha(s)}\left(q_{\alpha(s)r'}^{\Omega\setminus s} + q_{\alpha(s)\alpha(r')}^{\Omega\setminus s}\right). \end{aligned} \tag{A4}$$

Under assumption 1 (symmetry), the LHS remains unchanged if we replace the quantity $q_{\alpha(s')\alpha(r)}^{\Omega\setminus r}$ by $q_{s'\alpha(r)}^{\Omega\setminus r}$. Furthermore, the RHS does not increase if we replace the quantities by $q_{s'\alpha(r)}^{\Omega\setminus r}$ because the original quantities maximize the expression. We define $q^r := q_{s'\alpha(r)}^{\Omega\setminus r}$. Therefore, inequality (A4) holds if the following inequality is fulfilled:

$$2q^{\Omega\setminus r} \cdot p\left(q^{\Omega\setminus r}, q^{\Omega\setminus r}\right) - 2C\left(q^{\Omega\setminus r}\right) < 2q^{\Omega\setminus r} \cdot p\left(q^{\Omega\setminus r}, 0\right) - C\left(2q^{\Omega\setminus r}\right).$$

Dividing both sides by $2q^{\Omega\setminus r}$ yields

$$p\left(q^{\Omega\setminus r}, q^{\Omega\setminus r}\right) - \overline{C}\left(q^{\Omega\setminus r}\right) < p\left(q^{\Omega\setminus r}, 0\right) - \overline{C}\left(2q^{\Omega\setminus r}\right),$$

which can be rearranged to $-\Delta_p\left(q^{\Omega\setminus r}\right) > \Delta_C\left(q^{\Omega\setminus r}\right)$. As a result, we find that $W_{\Omega\setminus r} < W_{\Omega\setminus s}$ is fulfilled if the inequality $-\Delta_p\left(q^{\Omega\setminus r}\right) > \Delta_C\left(q^{\Omega\setminus r}\right)$ holds. ■

Proof of proposition 3. We start with the case where firm A is up for sale and compare the WTP for all possible orderings of (7), (8) and $U_A^{\{A,B,a,b\}}$.

Outcome 1. No acquisition takes place, i.e., $U_A^{\{A,B,a,b\}} > \beta_B$ and $U_A^{\{A,B,a,b\}} > \beta_a$. Rewriting these inequalities yields

$$U_A^{\{A,B,a,b\}} > \beta_B \quad \Leftrightarrow \quad W_\Omega > 2\, W_{\Omega\setminus B},$$

$$U_A^{\{A,B,a,b\}} > \beta_a \quad \Leftrightarrow \quad W_\Omega > W_{\Omega\setminus a} + W_{\Omega\setminus B}.$$

Outcome 2. Supplier B wins the auction, i.e., $\beta_B > U_A^{\{A,B,a,b\}}$ and $\beta_B > \beta_a$. Note that the value of β_B depends on $U_A^{\{A,B,a,b\}} \lesseqgtr \beta_a$, which can be rewritten as $3W_\Omega \lesseqgtr 2W_{\Omega\setminus a} + 4W_{\Omega\setminus B}$:

$$\beta_B > U_A^{\{A,B,a,b\}} \quad \Leftrightarrow \quad 2W_{\Omega\setminus B} > W_\Omega,$$

$$\beta_B > \beta_a \quad \Leftrightarrow \quad \begin{cases} W_\Omega > 2W_{\Omega\setminus a} & \text{if } 3W_\Omega > 2W_{\Omega\setminus a} + 4W_{\Omega\setminus B}, \\ W_{\Omega\setminus B} > W_{\Omega\setminus a} & \text{if } 3W_\Omega < 2W_{\Omega\setminus a} + 4W_{\Omega\setminus B}. \end{cases}$$

Outcome 3. A retailer wins the auction, i.e., $\beta_a > U_A^{\{A,B,a,b\}}$ and $\beta_a > \beta_B$. Note that the value of β_a depends on $U_A^{\{A,B,a,b\}} \lesseqgtr \beta_B$, which can be rewritten as $W_\Omega \lesseqgtr 2W_{\Omega\setminus B}$:

$$\beta_a > U_A^{\{A,B,a,b\}} \quad \Leftrightarrow \quad \begin{cases} W_\Omega < W_{\Omega\setminus a} + W_{\Omega\setminus B} & \text{if } W_\Omega > 2W_{\Omega\setminus B} \\ 3W_\Omega < 2W_{\Omega\setminus a} + 4W_{\Omega\setminus B} & \text{if } W_\Omega < 2W_{\Omega\setminus B}, \end{cases}$$

$$\beta_a > \beta_B \quad \Leftrightarrow \quad \begin{cases} 4W_{\Omega\setminus B} < W_\Omega + 2W_{\Omega\setminus a} & \text{if } W_\Omega > 2W_{\Omega\setminus B} \\ W_{\Omega\setminus B} < W_{\Omega\setminus a} & \text{if } W_\Omega < 2W_{\Omega\setminus B}. \end{cases}$$

If $W_\Omega > 2W_{\Omega\setminus B}$ and $W_\Omega > W_{\Omega\setminus B} + W_{\Omega\setminus a}$ hold, outcome 1 is the only possible solution. Otherwise, if $W_\Omega < 2W_{\Omega\setminus B}$ or $W_\Omega < W_{\Omega\setminus B} + W_{\Omega\setminus a}$, it follows from the above conditions that outcome 2 occurs under the condition $W_{\Omega\setminus B} > W_{\Omega\setminus a}$ and outcome 3 under the condition $W_{\Omega\setminus B} < W_{\Omega\setminus a}$.

We turn to the case where retailer a is up for sale and compare all orderings of (9), (10) and $U_a^{\{A,B,a,b\}}$.

Outcome 1. No firm acquires the target, i.e., $U_a^{\{A,B,a,b\}} > \beta_A$ and $U_a^{\{A,B,a,b\}} > \beta_b$:

$$U_a^{\{A,B,a,b\}} > \beta_b \quad \Leftrightarrow \quad W_\Omega > 2\, W_{\Omega\setminus b},$$

$$U_a^{\{A,B,a,b\}} > \beta_A \quad \Leftrightarrow \quad W_\Omega > W_{\Omega\setminus A} + W_{\Omega\setminus b}.$$

Outcome 2. A supplier wins the auction, i.e., $\beta_A > U_a^{\{A,B,a,b\}}$ and $\beta_A > \beta_b$. Note that the value of β_A depends on $U_a^{\{A,B,a,b\}} \lesseqgtr \beta_b$, which can be rewritten as $W_\Omega \lesseqgtr 2W_{\Omega\setminus b}$:

$$\beta_A > U_a^{\{A,B,a,b\}} \quad \Leftrightarrow \quad \begin{cases} W_\Omega < W_{\Omega\setminus A} + W_{\Omega\setminus b} & \text{if } W_\Omega > 2W_{\Omega\setminus b} \\ 3W_\Omega < 2W_{\Omega\setminus A} + 4W_{\Omega\setminus b} & \text{if } W_\Omega < 2W_{\Omega\setminus b}, \end{cases}$$

$$\beta_A > \beta_b \quad \Leftrightarrow \quad \begin{cases} 4W_{\Omega\setminus b} < W_\Omega + 2W_{\Omega\setminus A} & \text{if } W_\Omega > 2W_{\Omega\setminus b} \\ W_{\Omega\setminus b} < W_{\Omega\setminus A} & \text{if } W_\Omega < 2W_{\Omega\setminus b}. \end{cases}$$

Outcome 3. Retailer b wins the auction, i.e., $\beta_b > U_a^{\{A,B,a,b\}}$ and $\beta_b > \beta_A$. Note that the value of β_b depends on $U_a^{\{A,B,a,b\}} \lesseqgtr \beta_A$, which can be rewritten as $3W_\Omega \lesseqgtr 2W_{\Omega\setminus A} + 4W_{\Omega\setminus b}$:

$$\beta_b > U_a^{\{A,B,a,b\}} \quad \Leftrightarrow \quad W_\Omega < 2W_{\Omega\setminus b},$$

$$\beta_b > \beta_A \quad \Leftrightarrow \quad \begin{cases} W_\Omega > 2W_{\Omega\setminus A} & \text{if } 3W_\Omega > 2W_{\Omega\setminus A} + 4W_{\Omega\setminus b} \\ W_{\Omega\setminus b} > W_{\Omega\setminus A} & \text{if } 3W_\Omega < 2W_{\Omega\setminus A} + 4W_{\Omega\setminus b}. \end{cases}$$

If $W_\Omega > 2W_{\Omega\setminus b}$ and $W_\Omega > W_{\Omega\setminus A} + W_{\Omega\setminus b}$ hold, outcome 1 is the only possible solution. Otherwise, if $W_\Omega < 2W_{\Omega\setminus b}$ or $W_\Omega < W_{\Omega\setminus A} + W_{\Omega\setminus b}$, it follows from the above conditions that outcome 2 occurs under the condition $W_{\Omega\setminus A} > W_{\Omega\setminus b}$ and outcome 3 under the condition $W_{\Omega\setminus A} < W_{\Omega\setminus b}$. ■

Proof of corollary 3. Note that the outcomes of both propositions 2 and 3 depend on the condition $W_{\Omega\setminus a} \lesseqgtr W_{\Omega\setminus A}$. Corollary 3 results immediately from comparing the outcomes. ■

Appendix A2: Example of the application of the Shapley value

We focus on an industry structure with an upstream monopoly and non-integrated retailers (i.e., $\Psi = \{AB, a, b\}$) to demonstrate the use of the Shapley value. In this case, six orderings are possible, those displayed in table A2. We focus on the payoff of supplier AB.

TABLE A2
Marginal contributions in various orderings

		Marginal contribution		
	Ordering	AB	a	b
1	AB, a, b	0	$W_{\Omega\setminus b}$	$W_\Omega - W_{\Omega\setminus b}$
2	AB, b, a	0	$W_\Omega - W_{\Omega\setminus a}$	$W_{\Omega\setminus a}$
3	a, AB, b	$W_{\Omega\setminus b}$	0	$W_\Omega - W_{\Omega\setminus b}$
4	b, AB, a	$W_{\Omega\setminus a}$	$W_\Omega - W_{\Omega\setminus a}$	0
5	a, b, AB	W_Ω	0	0
6	b, a, AB	W_Ω	0	0

In orderings 1 and 2, supplier AB comes first. Its marginal contribution is zero because without a retailer preceding it, the supplier cannot bring its input to the market. Supplier AB comes second in orderings 3 and 4. In ordering 3, supplier AB's contribution is to enable production with retailer a, together creating $W_{\Omega\setminus b}$ of surplus. This is the surplus that can be created without retailer b. Similarly, in ordering 4, supplier AB enables production with retailer b and therefore generates $W_{\Omega\setminus a}$ of surplus.

In orderings 5 and 6, supplier AB comes last. Because the retailers preceding have no final goods to sell absent a supplier, firm AB's marginal contribution corresponds to the full industry surplus W_Ω in these orderings. Finally, taking expectations of the orderings with equal probabilities, the Shapley value yields as a payoff for the supplier:

$$U_{AB} = \frac{1}{6}\left[0 + 0 + W_{\Omega\setminus b} + W_{\Omega\setminus a} + W_\Omega + W_\Omega\right] = \frac{1}{6}\left[W_{\Omega\setminus b} + W_{\Omega\setminus a} + 2W_\Omega\right].$$

Appendix A3: Payoffs under various market structures

TABLE A3
Payoffs under various market structures

Market structure	Payoffs
Full separation $\{A,B,a,b\}$	$U_A = \frac{1}{12}\left[W_{\Omega\backslash Bb} + W_{\Omega\backslash Ba} + W_{\Omega\backslash b} - W_{\Omega\backslash Ab} + W_{\Omega\backslash a} - W_{\Omega\backslash Aa} + W_{\Omega\backslash B} - 3W_{\Omega\backslash A} + 3W_{\Omega}\right]$ $U_B = \frac{1}{12}\left[-W_{\Omega\backslash Bb} - W_{\Omega\backslash Ba} + W_{\Omega\backslash b} + W_{\Omega\backslash Ab} + W_{\Omega\backslash a} + W_{\Omega\backslash Aa} - 3W_{\Omega\backslash B} + W_{\Omega\backslash A} + 3W_{\Omega}\right]$ $U_a = \frac{1}{12}\left[W_{\Omega\backslash Bb} - W_{\Omega\backslash Ba} + W_{\Omega\backslash b} + W_{\Omega\backslash Ab} - 3W_{\Omega\backslash a} - W_{\Omega\backslash Aa} + W_{\Omega\backslash B} + W_{\Omega\backslash A} + 3W_{\Omega}\right]$ $U_b = \frac{1}{12}\left[-W_{\Omega\backslash Bb} + W_{\Omega\backslash Ba} - 3W_{\Omega\backslash b} - W_{\Omega\backslash Ab} + W_{\Omega\backslash a} + W_{\Omega\backslash Aa} + W_{\Omega\backslash B} + W_{\Omega\backslash A} + 3W_{\Omega}\right]$
Upstream monopoly $\{AB,a,b\}$	$U_{AB} = \frac{1}{6}\left[W_{\Omega\backslash b} + W_{\Omega\backslash a} + 2W_{\Omega}\right]$ $U_a = \frac{1}{6}\left[W_{\Omega\backslash b} - 2W_{\Omega\backslash a} + 2W_{\Omega}\right]$ $U_b = \frac{1}{6}\left[-2W_{\Omega\backslash b} + W_{\Omega\backslash a} + 2W_{\Omega}\right]$
Vertically integrated upstream monopoly $\{ABa,b\}$	$U_{ABa} = \frac{1}{2}\left[W_{\Omega\backslash b} + W_{\Omega}\right]$ $U_b = \frac{1}{2}\left[-W_{\Omega\backslash b} + W_{\Omega}\right]$
Downstream monopoly $\{A,B,ab\}$	$U_A = \frac{1}{6}\left[W_{\Omega\backslash B} - 2W_{\Omega\backslash A} + 2W_{\Omega}\right]$ $U_B = \frac{1}{6}\left[-2W_{\Omega\backslash B} + W_{\Omega\backslash A} + 2W_{\Omega}\right]$ $U_{ab} = \frac{1}{6}\left[W_{\Omega\backslash B} + W_{\Omega\backslash A} + 2W_{\Omega}\right]$
Vertically integrated downstream monopoly $\{Aab,B\}$	$U_{Aab} = \frac{1}{2}\left[W_{\Omega\backslash B} + W_{\Omega}\right]$ $U_B = \frac{1}{2}\left[-W_{\Omega\backslash B} + W_{\Omega}\right]$
Full integration $\{ABab\}$	$U_{ABab} = W_{\Omega}$
Single vertical integration $\{Aa,B,b\}$	$U_{Aa} = \frac{1}{6}\left[2W_{\Omega\backslash Bb} + W_{\Omega\backslash b} + W_{\Omega\backslash B} - 2W_{\Omega\backslash Aa} + 2W_{\Omega}\right]$ $U_B = \frac{1}{6}\left[-W_{\Omega\backslash Bb} + W_{\Omega\backslash b} - 2W_{\Omega\backslash B} + W_{\Omega\backslash Aa} + 2W_{\Omega}\right]$ $U_b = \frac{1}{6}\left[-W_{\Omega\backslash Bb} - 2W_{\Omega\backslash b} + W_{\Omega\backslash B} + W_{\Omega\backslash Aa} + 2W_{\Omega}\right]$
Double vertical integration $\{Aa,Bb\}$	$U_{Aa} = \frac{1}{2}\left[W_{\Omega\backslash Bb} - W_{\Omega\backslash Aa} + W_{\Omega}\right]$ $U_{Bb} = \frac{1}{2}\left[-W_{\Omega\backslash Bb} + W_{\Omega\backslash Aa} + W_{\Omega}\right]$

Supporting information

Supplementary material accompanies this article.

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