TETHERING VERTICAL MERGER ANALYSIS

BY DANIEL P. O'BRIEN[1]

1 Microfoundations, www.microfoundations.com. Technical notes that support this paper appear in "Tethering Vertical Merger Analysis – Technical Notes," hereinafter Technical Notes, available at https://www.microfoundations.com/technical.

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Antitrust practitioners are mis-applying simple vertical merger screening techniques (e.g. vertical foreclosure arithmetic, price pressure analysis) to reach flawed and internally inconsistent conclusions about vertical mergers. Specifically, practitioners have struck on a formula for claiming harm from vertical mergers: They argue that relatively low upstream margins mean that, post-merger, the merged firm has an incentive to disadvantage rivals' access to the upstream product thus driving more sales to the merged firm's relatively more profitable downstream product. This reasoning is backwards in the same way that standard critical loss analysis was backwards when it concluded that large pre-merger margins make harm from horizontal mergers less likely. A low upstream profit share implies that the upstream firm faces significant competition and likely lacks the ability to foreclose competition, whereas a high upstream profit share admits foreclosure as a possibility (though by no means a certainty). This paper discusses the issues and touches on how to fix them, a topic addressed in more detail in a forthcoming companion paper.

I. INTRODUCTION

Antitrust practitioners are mis-applying simple vertical merger screening techniques (e.g. vertical foreclosure arithmetic, price pressure analysis) to reach flawed and internally inconsistent conclusions about vertical mergers. Specifically, practitioners have struck on a formula for claiming harm from vertical mergers: They argue that relatively low upstream margins mean that, post-merger, the merged firm has an *incentive* to disadvantage rivals' access to the upstream product thus driving more sales to the merged firm's relatively more profitable downstream product. Yet, in doing so, they ignore the implications of the relatively low upstream margin for whether the upstream firm has the *ability* to divert sales in this way: If it did, it should be using that power to make more money pre-merger.

In more technical terms, practitioners use departure and diversion rates in their vertical math that are *untethered* from the relative margins that are at the heart of their incentive arguments. The result is a contradiction that leads to wrongful condemnation of vertical mergers — assuming that the upstream firm has a critical input but for some reason cannot use it to capture large margins pre-merger, with the "harm" from the vertical merger being that the merger somehow unlocks the power of what was already a critical input.

The problem is closely related to the misapplication of critical loss analysis that, for years, led practitioners to believe that horizontal mergers were less likely to be harmful if pre-merger margins were high rather than low.[2] In the same way, simple screening techniques that have become prominent in the analysis of vertical mergers indicate that they are *more* likely to lead to anticompetitive foreclosure or raising rivals' cost ("RRC") effects when upstream margins are *lower*. This reasoning, without more, is backwards for the same high-level reason that standard critical loss is flawed — in both cases, the analysis is not tethered to a coherent and internally consistent economic framework that explains the pre-merger margins that serve as critical inputs into the analysis.

The remainder of this paper refers to the class of out-of-equilibrium screening techniques currently being used to analyze vertical mergers as "untethered vertical math," or "UVM." The paper explains why tethering the vertical math to a coherent model — which often boils down to tethering the assumed departure and diversion rates to observed relative margins — substantially changes and very often reverses the predictions of vertical math models, particularly once the long-recognized efficiencies from vertical mergers (e.g. elimination of double marginalization, related benefits from combining complements) are incorporated. The goal is to be constructive — not to tear down vertical math, but to explain both intuitively and rigorously what is wrong when it is untethered, and to describe (in general terms) how to repair vertical math by tethering it.

II. UVM IS INCONSISTENT WITH THE ECONOMICS OF VERTICAL CONTRACTING AND VERTICAL MERGERS

A. Illustrative Example and Intuition

An example representing a typical vertical merger scenario illustrates the problems with UVM. Suppose an upstream firm sells an input used by two competing downstream firms to produce a product. There is some competition in the input market, although the extent of that competition is in dispute, and the upstream firm is argued by at least some to be "dominant." The upstream firm and one of the downstream firms propose to merge.

The following fact — prevalent in many recent vertical merger cases — is known: The upstream profit margin per unit of final output is small relative to total unit profit margin generated by merging upstream product.[3] To be concrete, suppose upstream profit is one-tenth the total profit generated using the upstream firm's input, including the margin on downstream sales. Based on this fact, a complainant seeking to block the merger makes the following argument:

- The cost of foreclosing (withholding input supply from the unintegrated downstream firms) per unit foreclosed is the upstream unit margin.
- The benefit of foreclosure per unit foreclosed is the integrated firm's unit margin, which includes the downstream margin.
- Because the upstream unit margin is only one-tenth the total (integrated) unit margin, the benefit of foreclosure will exceed the cost if at least 10 percent of the units lost by the upstream firm divert to the merged firm.
- Because it is likely that more than 10 percent of the units lost by the upstream firm due to foreclosure will be recaptured by the merged

2 See Daniel P. O'Brien & Abraham Wickelgren (2003), "A Critical Analysis of Critical Loss Analysis," *Antitrust Law Journal*, 71:161 and Michael Katz & Carl Shapiro (2002) "Critical Loss: Let's Tell the Whole Story," *Antitrust*, 17:49.

3 Unit margins (profit per unit) rather than percentage margins are the critical variables for analyses like vertical arithmetic and vertical pricing pressure.

firm — based on an argument that the upstream firm is "dominant" — foreclosure is likely to be profitable, and it would harm competition.

This simple cost-benefit analysis illustrates the "foreclosure arithmetic" variant of UVM; similar logic underlies pricing (e.g. vGUPPI) versions of the argument. Analysis like this appears regularly in Agency dialog with parties proposing vertical mergers, and it appears in recent formal complaints against such mergers.[4] In the author's recent experience, it is the single most prominent line of argument currently used by the Agencies to determine whether to challenge vertical mergers.

To introduce the flaws in this line of argument, I start with a simple, intuitive inference based on the upstream firm's profit share in the distribution chain. A premise of the UVM in the illustration is that the upstream firm has high market power and thus the *ability* to foreclose downstream competitors. If true, one would expect the upstream firm to capture a relatively large share of the total profits generated by its presumptively critical input. However, the upstream firm's share of the profit generated by its presumptively critical input in the illustration is only ten percent — and that small share is critical to the argument about incentives to foreclose.

Despite the relatively small observed upstream share, the complainant alleges that the upstream firm will have the *power* to foreclose unintegrated rivals and raise price post-merger, and the UVM presented indicates that the foreclosure would be profitable. An obvious question presents itself: If the upstream firm will have the power to foreclose unintegrated rivals after the merger, why is it getting only 10 percent (or any small percentage) of the profit generated by its critical input prior to the merger?

This question is not a rhetorical question, but rather one that must be answered. And an answer should be available within the same analytical framework — here the foreclosure variant of UVM — used by the complainant to predict anticompetitive merger effects. If the framework can be adjusted (parameters calibrated) to explain the per-merger margins, then this should be done before using the framework. In contrast, if the framework cannot explain critical pre-merger observables like relative profit margins, why would one possibly expect it to predict merger effects accurately?

UVM makes no attempt to explain why the upstream firm's profit share would be so small if it has the power to harm competition by foreclosing unintegrated competitors. UVM is an out-of-equilibrium analysis that simply takes pre-merger observables as given without drawing any inferences about what they mean for the competitive environment. Note that none of this is a condemnation of vertical math, rather it is a condemnation of the lack of tethering, which can create problems in any out-of-equilibrium economic analysis, viz., standard critical loss analysis.

Basic economic intuition and the more rigorous economics presented below would interpret the upstream firm's low profit share as an indication that the upstream firm likely does not have the power to foreclose competition significantly after the merger. Indeed, standard economic logic implies that the lower the upstream profit share, the lower the potential for anticompetitive foreclosure, which is precisely the opposite prediction from that made by UVM.

B. Inferences from the Economics of Vertical Pricing

Standard economics of vertical pricing allow clear inferences to be made about upstream market power based on pre-merger upstream and downstream unit margins. These inferences are missed in UVM, which uses profit margins and rates of diversion in response to foreclosure or RRC strategies as inputs into the analysis without tethering to observed margins the upstream firm's power to induce that diversion. In the example above, the upstream firm's profit share is small. If the upstream firm had the power to foreclose or raise the costs of unintegrated downstream competitors after the merger significantly, it would charge a much higher price and capture a higher profit share.

To see this more formally, consider the classic textbook case of linear demand for the downstream product, constant marginal cost, fixed proportions between the input and output (e.g. one unit of the input is required to produce one unit of the output), and take-it or leave-it ("TIOLI") price-setting by the upstream monopolist (I discuss bargaining below). If the upstream firm has monopoly power and sells to a monopolist in the downstream market (not the relevant scenario but informative as will become clear), its unit margin will be two times higher than the downstream firm's unit margin.[5] If instead the upstream firm sells to multiple competitors in the downstream market, downstream unit margins will be smaller,

4 *In the Matter of Nvidia and Arm: "*Post-Acquisition, the combined firm would likely have a substantial incentive to engage in foreclosure strategies because the profits from additional sales of [each of three relevant products] would be higher than any foregone proceeds of licensing Arm Processor Technology to Nvidia's [relevant product] rivals." There are other recent examples at Agencies in the US and Europe.

5 See any textbook, e.g. Dennis Carlton & Jeffrey Perloff (2005), *Modern Industrial Organization*, 4th ed, pp. 415-417; Roger Blair & David Kaserman (2009), *Antitrust Economics*, 2nd ed, Chapter 14; and Jean Tirole (1988), *The Theory of Industrial Organization*, MIT Press, Exercise 4.1, p. 175.

and the upstream firm's unit margin will be *more than two times higher than the downstream unit margin*.[6] That is, an upstream monopolist will earn substantially greater unit margins than the downstream sellers that use its input, a far cry from the recent cases in which upstream margins far below downstream margins are used to argue for vertical harm.

The basic point is that upstream monopoly power means the upstream firm can extract a large share of the available rents. This point applies more generally than the textbook case with linear demand and can be illustrated in a variety of ways. For example, one method used in the economic literature shows that if the upstream firm had upstream monopoly power, the ratio of the upstream unit margin to downstream unit margins would equal the "Numbers Equivalent" measure of the effective number of downstream competitors divided by the industry pass-through rate:[7]

$$\frac{\text{Upstream Unit Margin}}{\text{Downstream Unit Margin}} = \frac{\text{Numbers Equivalent}}{\text{Pass-through Rate}}$$

To interpret this expression, suppose as an example that the number of downstream competitors is at least 2 and the pass-through rate is no higher than 1. Then if the upstream firm had monopoly power, the upstream unit margin would be at least two times the downstream margin.

Contrasting this result from economic theory with the actual margins in the illustration (in which the upstream firm captured only ten percent of profits) makes clear that the upstream firm in the illustration does not have anything approaching monopoly power. Its share of the profit generated by its "monopoly" input is only a small fraction of what that share would be if it had monopoly power. There is a sharp disconnect between the relative margins used to argue for an incentive to foreclose and the asserted ability to do so.

The most plausible explanation for the upstream firm's small profit share — which indicates that the upstream firm has little ability to extract a significant share of downstream rents — is that it faces competitive constraints in the upstream market. These constraints could come from some combination of alternative suppliers of its products, self-supply by downstream firms, purchases of alternative substitute products, and the option not to purchase. The relative margins of upstream firms tell us these constraints must exist, and if they do not show up in shares in a putative market or in a selection of documents, then those shares and documents are missing important constraints. Put simply, if there were not such constraints, the upstream firm would be extracting much more value from downstream firms than it actually is. And because these constraints are unlikely to meaningfully lessen with the merger, theories of harm that do not account for these constraints are not coherent as a matter of economics and are very likely to predict a risk of merger harm where none exists.

III. BARGAINING AND NONLINEAR PRICING DO NOT SAVE UVM

A. Bargaining

In some recent merger cases (e.g. *AT&T-Time Warner*), the government has focused on bargaining-based theories of harm, pursuing the idea that even if traditional take-it-or-leave-it models did not produce harm from vertical mergers, bargaining models might. Similarly, one might postulate that the contradiction between upstream market power and low upstream unit margins could disappear if input prices were determined through bargaining. It does not. This section explains that allowing for bargaining still leaves the core tension that plagues UVM: Relatively low upstream margins imply that the upstream firm faces some form of competition giving the downstream firms options that must be — but often are not — accounted for in an analysis of vertical merger effects.

For illustration, suppose that the demand for the final product is described by the following inverse demand function, $P = 100 - Q$, where P is the final price of the downstream product and Q is total quantity produced by downstream firms. Assume that one unit of the input is required for one unit of output, and for simplicity (but without any loss of generality), assume that all firms have zero production costs.

In the textbook model where the upstream firm has all the bargaining power and sets the input price unilaterally, the profit maximizing input price under these assumptions is $50. If the downstream firm is also a monopolist, the profit-maximizing final price is $75, and the down-

6 *Id.*

7 For a derivation of this result, see Technical Notes. The Numbers Equivalent in the downstream market is the number of equally-sized Cournot competitors that would yield the observed downstream margins under whatever form of rivalry prevails. See, e.g., Morris Adelman (1969), "Comment on the 'H' Concentration Measure as a Numbers-Equivalent," *Review of Economics and Statistics*, pp. 99–101.

stream margin is \$25 [= 75 – 25], while (given zero production costs) the upstream margin is \$50. Consistent with the earlier discussion, the upstream profit margin is two times the downstream margin.

When bargaining power is equally distributed, the profit margins change. Suppose the upstream firm engages in simultaneous Nash bargaining ("Nash-in-Nash" bargaining) with each of N downstream competitors.[8] If downstream firms are Cournot competitors, it can be shown that the Nash-in-Nash solution under standard assumptions about disagreement profits yields a wholesale price equal to \$25 irrespective of the number of downstream firms.[9] Thus the upstream unit margin is \$25 irrespective of the number of downstream firms. If there are N downstream firms, the downstream price is $p(N) = \left(100 + 25N\right)/(N+1)$. If , price is \$50, and the downstream unit margin is the same as the upstream unit margin: \$25. As the number of downstream firms increases from 2, the downstream unit margin falls so that the upstream unit margin exceeds the downstream unit margin. Thus, when foreclosure or RRC concerns are issues (meaning that there are downstream competitors that could be foreclosed, i.e. $N \geq 2$), the model predicts that, with an upstream monopolist and downstream Cournot competition, the upstream unit margin is never less than the downstream unit margin. And recall that UVM predicts that foreclosure is profitable only when the upstream unit margin is less than half the downstream unit margin. This never happens in the linear bargaining model with an upstream monopolist and downstream Cournot competition.

What is the appropriate conclusion if pre-merger evidence shows that, in cases where the input prices are negotiated, the upstream firm earns a small fraction of the total industry profit? The Nash-in-Nash bargaining model presented above, in which there is an upstream monopolist and downstream firms have no outside options, simply cannot explain these facts. Instead, to explain this pattern in the relative margins, downstream firms must have credible threats to pursue outside options,[10] such as alternative suppliers, backward integration, or a credible threat to take some action that hurts the supplier if it prices too high (e.g. invest to create a new supplier in the future). Critically, in this case, as long as the merged firm continues to sell to unintegrated downstream firms post-merger, the merger would likely be pro-competitive because the outside option would determine the input price charged to unintegrated downstream firms both before and after the merger and the merging downstream firm's effective marginal cost would fall due to the elimination of double marginalization.

The bargaining models discussed above assume as Nash did that upstream and downstream firms have equal "bargaining weights." One alternative approach in the literature to try to square small upstream profit margins with high upstream market power is to assume that the upstream firm has little bargaining power in negotiations with downstream firms, as reflected in a lower bargaining weight that puts smaller weight on the upstream firm's preferences than on the downstream firm's preferences. In my view, there are intuitive, theoretical, and antitrust policy problems with this approach, which render it an unsatisfying way to explain low upstream profits shares.[11]

At an intuitive level, why would an upstream monopolist that has high market power have so little bargaining weight that it receives only a small fraction of the profits generated by its critical input? In a real sense, this approach is quite non-economic — rather than use relative margins to derive implications about the extent of competition, as is standard in antitrust, this approach simply adjusts a "bargaining power" term that allows any pre-merger margins to be reconciled with a pre-conceived notion that the upstream firm has market power. At a theoretical level, modern bargaining theory associates relative bargaining weights with firms' relative degrees of patience in bargaining.[12] There is no reason to believe that the discount rate of an upstream firm is many times higher than the discount rates of downstream firms, which would be required to generate bargaining weights that explain a small upstream profit share. As a matter of antitrust policy, such an approach would favor enforcement to block mergers in situations where upstream firms control critical inputs but have little bargaining power to capture returns on those inputs,

8 Following standard theory, Nash bargaining requires specifying the profits earned by the bargaining parties upon reaching agreement and the disagreement profits they earn should they disagree. I assume that when only one downstream firm has an agreement, it operates as a monopolist, and the upstream firm earns a disagreement profit equal to the wholesale profits from selling to a downstream monopolist at the equilibrium wholesale price. I assume that each downstream firm has a disagreement profit of zero. These are standard assumptions.

9 See Daniel P. O'Brien (1989), "Section 4.1: N-Firm Bargaining," and "Section 4.4: Other Applications: Vertical Integration," from his doctoral dissertation. See https://www.microfoundations.com/technical. As discussed in the Vertical Integration section, a vertical merger between an upstream monopolist and a downstream Cournot oligopolist in the linear simultaneous bargaining model predicts an anticompetitive price increase if there are three or more downstream firms. However, the upstream profit share exceeds 50 percent in all of those cases. If the upstream profit share is less than 50 percent, the implication is that downstream buyers have outside options that are not accounted for in the model (or in UVM).

10 An outside option for a downstream firm in negotiations with an upstream firm is the downstream firm's ability to choose an outside alternative in lieu of an agreement with the upstream firm. Outside options act as constraints on the Nash bargaining solution. See Ken Binmore, Ariel Rubinstein & Asher Wolinsky (1986), "The Nash Bargaining Solution in Economic Modelling," *The RAND Journal of Economics*, pp 176-188.

11 This approach is proposed in Gloria Sheu & Charles Taragin (2022), "Simulating Mergers in a Vertical Supply Chain with Bargaining," forthcoming in The RAND Journal of Economics.

12 See Binmore et al. (1986), *supra* note 10.

and thus would tend to lock in situations in which upstream firm have little ability to capture returns on investment in their product and thus little incentive to invest.[13]

B. Nonlinear Pricing and Bargaining

It is well known that nonlinear pricing can alter the implications of the textbook model of vertical pricing. However, nonlinear pricing with or without bargaining does not save UVM. The core problem with UVM is that it does nothing to reconcile the upstream firm's profit share with the assumption that the upstream firm has substantial market power. This problem is present with or without nonlinear pricing just as it is present with or without bargaining.

To see this, consider the economic environment known to be most conducive to anticompetitive effects from vertical mergers: bilateral bargaining over nonlinear contracts (let's say two-part tariffs) that are private information to downstream firms who have passive beliefs. In this setting, the upstream firm and each downstream firm choose a wholesale price equal to marginal cost and negotiate fixed transfers to divide bilateral surplus.[14] If the transfers are negotiated through Nash bargaining, the upstream profit share will exceed 50 percent. The reason is that Nash bargaining selects transfers to equalize the upstream and each downstream firms' bilateral gains from trade. Because an upstream monopolist's disagreement profit in bilateral bargaining exceeds that of each downstream firm (because the upstream firm sells to multiple downstream firms), the fixed fee that equalizes bilateral gains from trade gives the upstream firm more than half the bilateral profits.[15] So, even with non-linear pricing, the assumption of upstream monopoly power is inconsistent with relatively small upstream profit margins.

C. Application to vGUPPI Analysis

The discussion to this point has focused on the foreclosure arithmetic variant of UVM, but it is important to recognize that price pressure variants (e.g. vGUPPI) of UVM raise the same high-level issue — the contradiction between low upstream profit shares and the assumption that the upstream firm has substantial market power. vGUPPIs, for example, predict greater upward pressure on the input price the greater the value of sales diverted from unintegrated rivals to the merging downstream firm in response to a RRC strategy. Holding diversion and final prices fixed, the vGUPPI is higher the smaller the upstream profit share because a smaller upstream profit share means a greater downstream profit share and thus a higher value of sales diverted to the downstream partner. The critical phrase here is "holding diversion fixed," as it runs into the same logical problem as UVM: Of course, an upstream firm that makes little profit but would have the power to divert substantial sales to its downstream partner would choose to exercise this power in order to increase its profits. But if it has such power, then why are its profits low? Even pre-merger it should be able to use its power to determine to demand a high share of profits. Thus, the logical problems that arise with the foreclosure variant of UVM also arises with vGUPPIs.

Similarly, in the recent cases involving mergers in the cable industry, rather than vGUPPIs, analyses of price pressure were used that assumed that input prices are negotiated. Those analyses were much like vGUPPIs except for the bargaining element. As explained above, bargaining does not reconcile the observation of low upstream profit shares with the assumption that the upstream firm has substantial market power.

IV. TETHERING VERTICAL MERGER ANALYSIS

A lot of economics is buried in the "diversion" that occurs in response to a foreclosure or RRC strategy. Focusing on foreclosure, when the merged firm withholds inputs required to produce 10 units of output from an unintegrated downstream firm, some of the foreclosed firm's customers who would have purchased those units "divert" to an alternative. The customer's alternatives include: (i) stop purchasing the product altogether; (ii) switch to a competing downstream firm that uses a competing input; (iii) switch to a competing downstream firm that uses the merged firm's input (unlikely if all competing downstream firms are foreclosed); and (iv) purchase the product produced by the foreclosed downstream firm

13 One might argue that the upstream firm could sell itself to a non-strategic buyer that is better at bargaining. But note that this increase in bargaining power would itself lead to higher upstream prices *without* generating the efficiencies (such as elimination of double marginalization) that come from a vertical merger.

14 See Oliver Hart & Jean Tirole (1990), "Vertical Integration and Market Foreclosure," *Brookings Papers on Economic Activity: Microeconomics*, 205-286 (the case of downstream Cournot competition); and Daniel P. O'Brien & Greg Shaffer (1992), "Vertical Control with Bilateral Contracts," *The RAND Journal of Economics*, 299-308 (the case of downstream Bertrand competition).

15 Suppose that downstream firm A's profits excluding the fixed fee are Π and the fixed fee is F. The downstream firm's gains from an agreement with the upstream firm are then $\Pi - F$. Because the upstream firm sells to multiple downstream firms, its earns a positive disagreement profit $\bar{\Pi}$ if it does not reach agreement with downstream firm A. Thus, the upstream firm's gains from agreeing with downstream firm A are $\Pi + F - \bar{\Pi}$. The fixed fee that equalizes gains from trade between the upstream firm and downstream firm A is $F = (\Pi + \bar{\Pi})/2$, which gives the upstream firm more than half the bilateral profits.

using a competing input. These possibilities can be summarized in two variables: the diversion ratio from foreclosed downstream firm(s) to the merged downstream firm, which is in the first three effects; and the departure rate, which is in the fourth effect.

The diversion ratio in this context is standard — it is the ratio of the increase in the merged firm's unit sales to the reduction in the unit sales of the foreclosed firms in response to the foreclosure, which measures the degree of product substitution in the downstream market.

The departure rate — which depends on the ability to use an alternative input—is where the bodies are buried. The departure rate is the ratio of the change in the foreclosed firm's unit sales to the unit sales foreclosed, which a measure the rate at which units *depart* foreclosed firms in response to the foreclosure strategy. The departure rate measures product substitution in the upstream rather than the downstream market. Obviously, the departure rate will be smaller the greater the number of competitive options downstream firms have — that is, the greater the extent of competition, in various forms, that the upstream firm faces.

This critical role of the departure rate is made clearer by writing out the expressions for profitable foreclosure and vertical upward pricing pressure. In the foreclosure variant of UVM, foreclosure is profitable when[16]

$$\text{Diversion Ratio} \times \text{Departure Rate} > \frac{\text{Upstream Unit Margin}}{\text{Upstream Unit Margin} + \text{Downstream Unit Margin}}.$$

In the vGUPPI variant of UVM, the gross upward pricing pressure component of the index (before dividing by price to create an index), is

$$\text{vGUPPI} = \text{Diversion Ratio} \times \textit{Departure Rate} \times \textit{Downstream Unit Margin}.$$

These expressions show that both foreclosure arithmetic and vGUPPI analysis predict less harm from a vertical merger the smaller the departure rate. The idea is that if unintegrated downstream firms have options that constrain upstream pricing, an attempt to foreclose them or to raise their costs would create little harm because downstream firms would respond by pursuing those options such that the departure rate would be small.

The biggest problem with UVM is that the departure rate typically is not *tethered* in any serious way to pre-merger information about the competitive constraints the upstream firm faces. In many cases, including recent vertical merger complaints, UVM is presented with no reference to the distinction between the diversion ratio and the departure rate. In cases where the distinction is discussed, no attempt is made to check the consistency of the assumed departure rate with the upstream profit share.

The resolution to this problem is to use an economic framework that recognizes the implications of the upstream profit share for the ability of the downstream firms to discipline the merging upstream, i.e. a framework that tethers the departure rate to the upstream profit share.

There are at least three ways to accomplish this resolution: (A) empirically estimate the departure rate and using it appropriately in tethered vertical math ("TVM");[17] (B) use an economic model that considers the implications of upstream profit margins to determine the departure rate to use in TVM; or (C) use an economic model (e.g., a calibrated simulation model) to predict merger effects. While full discussion of these three potential solutions are beyond the scope of this paper, the basic idea of each is simple: (A) with sufficient variation in the data, one could econometrically estimate the departure rate if the upstream input is made more expensive or withheld; (B) one could add a parameter for the departure rate to vertical math or vGUPPI models and calibrate it such that pre-merger margins are matched; (C) or one could develop a full simulation model, in which the market is in equilibrium pre-merger, with all shares and margins explained by the model, and then one simulates the effect of the merger. Any of these can potentially solve the problem, but all are challenging, and there is scope for additional work — to which I and colleagues intend to contribute — on proper application of each. What is clear is that some such method must be used, as the untethered methods in practice today are internally contradictory and yield flawed results, just as the untethered critical loss analysis, which was once popular, was shown to do.

16 For a rigorous derivation of these formulas, see Technical Notes.

17 A proxy sometimes used for the departure rate is the upstream firm's market share, the idea being that the lower the upstream firm's share the more competition it faces and the lower the departure rate. This approach is far from a complete analysis. For example, in settings where downstream firms choose a single supplier, the incumbent's share might be high even though downstream firms would switch to alternative suppliers in the event of a price increase, in which case the relevant departure rate would be low.

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