COMMENT ON THE U.S. DEPARTMENT OF JUSTICE AND THE FEDERAL TRADE COMMISSION DRAFT VERTICAL MERGER GUIDELINES

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In recent decades there has been an explosion of interest and research in bargaining models and their use in industrial organization problems. In particular, they have been used to model behavior in upstream markets where it is often the case that both sides of the market are highly concentrated, and it is therefore reasonable to expect that bargaining power is split between both sides of the market. A new competitive effect of vertical mergers emerges when bargaining between upstream firms and downstream firms is taken into account. The main idea is that a vertical merger will allow the merged firm to increase the price that it charges rival downstream firms for inputs by increasing its bargaining leverage over these downstream firms. Its bargaining leverage increases because it now takes into account the additional profit that its own downstream division will earn if it withholds inputs from downstream rivals. One strong appeal of this theory is that it provides a simple and very intuitive formula to measure the upward pricing pressure caused by a vertical merger due to changes in bargaining leverage, based on variables whose values can generally be estimated using available data. This has been the primary theory of harm that government authorities in both the United States and abroad have relied on in their analysis of important recent vertical merger cases. I recommend that drafters of the new guidelines consider providing a more complete discussion of this theory of harm in the guidelines. I have attached a recent paper I wrote describing this theory of harm and the role it has played in a number of important recent vertical merger cases.

Modelling and Predicting the Competitive Effects of Vertical Mergers: The Bargaining Leverage Over Rivals (BLR) Effect* **

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Abstract. A new competitive effect of vertical mergers, based on the Nash bargaining model, has begun to play an important role in antitrust authorities' evaluations of vertical mergers in the United States, Canada and abroad. The key idea is that a vertical merger will increase the bargaining leverage of the merged firm over its downstream rivals. Its bargaining leverage increases because it now takes into account the additional profit that its own downstream division will earn if it withholds inputs from downstream rivals, which changes its threat point in the bargaining game with downstream rivals. Consequently, the merged firm can increase the price that it charges rival downstream firms for inputs. One strong appeal of this theory is that it provides a simple and very intuitive formula to measure the upward pricing pressure caused by a vertical merger due to changes in bargaining leverage, based on variables whose values can generally be estimated using available data. This article describes this new competitive effect, which will be called the Bargaining Leverage over Rivals (BLR) effect, and derives the upward pricing pressure formula. It also explains why this new competitive effect is distinct from the older Raising Rivals' Costs (RRC) effect that has been widely discussed in the economics literature, and discusses the relationship between the two different effects.

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1. Introduction

A long-standing concern in antitrust policy is that a vertical merger might result in the vertically-integrated firm raising input prices to downstream rivals or perhaps even foreclosing them completely, which will, in turn, harm consumers in the downstream market.[1] For many years, the leading (and, in fact, only) theory providing a theoretical foundation for such a result was the Raising Rivals' Costs (RRC) theory, originally due to Salop and Scheffman (1983).[2] The basic idea of the RRC theory is that a vertical merger between an upstream firm and a downstream firm increases the merged firm's incentive to raise input prices to downstream rivals because it recognizes that increasing the input price it charges to downstream rivals will raise these rivals' costs in the downstream game. This, in turn, will cause downstream prices to rise, thereby increasing the profit of its own downstream affiliate. A key assumption of the RRC theory is that upstream input prices are set before downstream prices, so that a rational entity choosing input prices will account for how input prices affect equilibrium prices in the downstream market.

Reflecting the technical tools available and in common use at the time it was created, the RRC model assumes that the upstream firm has all of the bargaining power and makes take-it-or-leave-it offers to downstream firms. In recent decades there has been an explosion of interest and research in bargaining models and their use in industrial organization problems. In particular, they have been used to model behavior in upstream markets where it is often the case that both sides of the market are highly concentrated, and it is therefore reasonable to expect that bargaining power is split between the two sides.[3]

A new competitive effect of vertical mergers emerges when bargaining between upstream

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[1]See Riordan (2008) for a comprehensive review and synthesis of the economics literature on the competitive effects of vertical mergers. See Salop (2018) for a recent policy-oriented discussion of the literature.

[2]Also see Krattenmaker and Salop (1986) and Salop and Scheffman (1987). See Moresi and Salop (2013) for a recent comprehensive treatment of this theory.

[3]The Nash bargaining model (Nash 1950) is generally used in the economics literature to model the outcome of bilateral bargaining. Horn and Wolinksy (1988) is the seminal paper that employed the Nash bargaining model to model equilibrium in vertically related markets where bargaining power in upstream markets is split between buyers and sellers. Other papers in this literature include Binmore *et. al.* (1986), Chipty and Synder (1999), Collard-Wexler *et. al.* (2019), Crawford *et. al.* (2018), Crawford and Yurukoglu (2012), Cuesta *et. al.* (2019), Dafny *et. al.* (2019), Das Varma and De Stefano (2018), De Fontenay and Gans (2014), Domnenko and Sibley (2019), Dragenska *et. al.* (2010), Gaudin (2018), Gowrisankaran *et. al.* (2015), Ho and Lee (2017), Iozzi and Valleti (2014), Nevo (2014) and Sheu and Taragin (2017).

firms and downstream firms is taken into account. This new effect, which I will call the Bargaining Leverage over Rivals (BLR) effect, is the subject of this paper. The new effect occurs because a vertical merger affects the disagreement payoff of the upstream firm when it negotiates with a rival downstream firm. Its disagreement payoff is increased because it takes into account the extra profit that its own downstream affiliate will earn if the input is withheld completely from the rival. The upstream firm's disagreement payoff is irrelevant to determining the price of exchange when it has all of the bargaining power. However, it becomes relevant as soon as the upstream firm does not have all of the bargaining power, and it becomes increasingly more important as bargaining power shifts from the upstream firm to the downstream firm. In the limit, as the downstream firm has all of the bargaining power, the BLR effect is the only effect determining the price of exchange.

The BLR effect occurs because a vertical merger changes the disagreement payoff of the upstream firm in its negotiations with downstream rivals. However, a more intuitive way to think about this effect is that the vertical merger increases the merged firm's opportunity cost of providing the input to downstream rivals. The new opportunity cost recognized by the merged firm is the forgone profit that its own downstream affiliate would earn if the input was withheld from rivals. The Nash bargaining model predicts that a share of any cost increase will be passed through to the negotiated price so long as the seller does not have all of the bargaining power. This is why a vertical merger will cause negotiated input prices to rise even if all parties negotiating input prices completely ignore the possibility that upstream prices may have an effect on downstream prices.

We can think of the RRC effect as increasing the *incentive* of the upstream firm to raise input prices, while the BLR effect increases the *ability* of the upstream firm to raise input prices. In the simple RRC model, the upstream firm has all of the bargaining power. Therefore, the upstream firm can unilaterally set a price that maximizes its profit both before and after the merger. The RRC effect occurs because the vertical merger increases the profit-maximizing input price. If the upstream firm does not have all of the bargaining power, an additional effect emerges. The upstream firm does not set a profit-maximizing price either before or after the merger, because it does not have all of the bargaining power. The BLR effect occurs because a vertical merger increases the upstream firm's bargaining leverage by increasing its disagreement payoff, allowing it to bargain for a price that is closer to the profit-maximizing price.

If we add bargaining between the upstream firm and downstream firms to the simple RRC model and maintain the assumption that input prices are set before output prices, this yields a relatively complex model where both the RRC effect and the BLR effect are present. However, the analysis is dramatically simplified if one instead assumes that upstream and downstream prices are set simultaneously, primarily because this simplifies the Nash bargaining problem.[4] A simple intuitive formula can be derived to measure the upward pricing pressure caused by a vertical merger due to changes in bargaining leverage, based on variables whose values can

[4]In this case, the total surplus created by the exchange becomes fixed, and the negotiated input price only affects the split of a fixed amount of surplus between the parties.

generally be estimated using available data. In addition, if input prices and output prices are set simultaneously, there is no longer a RRC effect, because entities negotiating over input prices take downstream prices as fixed. This means that the entire remaining effect is a BLR effect. Following terminology introduced by Moresei and Salop (2012), who suggest that measures of pricing pressure due to vertical mergers be termed "vertical GUPPIs" or "vGUPPIs," this paper will refer to the measure of upward pricing pressure as the vertical GUPPI due to the BLR effect, and denote it by $vGUPPI_{BLR}$.[5] The assumption that upstream and downstream prices are determined simultaneously also permits the derivation of a very simple and intuitive formula to determine if the vertical merger will result in full foreclosure, where, once again, the formula is based on variables whose values can generally be estimated using available data.

One can justify the assumption that input and output prices are set simultaneously in different ways.[6] Most simply, one can argue that even if the assumption is not completely correct, it is a useful simplification that sheds significant light on the issue of what economic factors affect the magnitude of the BLR effect. However, it can also be argued that which modeling assumption better predicts actual outcomes is an empirical issue that cannot be settled by theoretical arguments alone. This subject will be returned to in Section 4 of the paper which presents and discusses the formal model.

A wave of high-profile vertical mergers between video programmers and pay-TV providers has swept through the video programming and distribution industry over the past two decades. In this industry, upstream programmers that create TV channels (e.g., Disney, Viacom, Time Warner, NBCU) license these channels to downstream pay-TV providers that distribute this programming to consumers (e.g., Comcast, Charter, AT&T, Verizon, DISH, DirecTV). 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. An early attempt to inject bargaining theory into the antitrust review of vertical mergers was Rogerson's (2003a, 2003b) submissions to the Federal Communications Commission (FCC) when it considered the News Corp./DirecTV merger. Rogerson (2003a, 2003b) identified the BLR effect, explained why it was distinct from the RRC effect, and argued that even if the vertical merger did not make foreclosure profitable, it would still increase the vertically-integrated firm's bargaining leverage and therefore allow the vertically-integrated firm to raise programming prices to rival distributors. At that time, perhaps because the theory was relatively novel, it played only a small role in shaping the FCC's final analysis. Although the FCC payed some lip service to the theory, it focused primarily on the issue of whether the merger would make either permanent or temporary foreclosure profitable.[7]

[5]Moresi and Salop (2013) show how to construct such measures in the original RRC model.

[6]Other papers on vertically related markets that make the assumption that upstream and downstream prices are determined simultaneously include Crawford *et. al.* (2018), Draganska *et. al.* (2010), Nocke and White (2007) and Sheu and Taragin (2017).

[7]See FCC (2004) for the FCC order describing its analysis of the transaction.

However, when Rogerson (2010a, 2010b, 2010c) and Murphy (2010a, 2010b) presented the same theory to the FCC when it considered the Comcast/NBCU merger, with the addition of the simple formula for calculating the upward pricing pressure due to the BLR effect, this theory played a major role in shaping the FCC's analysis.[8] Although the FCC did not block the merger, it placed significant conditions on the merged firm intended to limit Comcast/NBCU's ability to raise programing prices charged to rival distributors. Subsequently, this became the primary theory of harm used by the Department of Justice (DOJ) to try and block the AT&T/Time Warner merger.[9] It has also been used by antitrust authorities outside the United States in several vertical merger cases between video programmers and distributors.[10] The theory that a vertical merger can increase the bargaining leverage of a vertically-integrated firm when it negotiates input prices with downstream rivals and the formula for calculating the upward pricing pressure induced by a vertical merger because of this effect seems likely to continue to play an important role in the analysis of future vertical mergers in both the video programming and distribution industry and other industries.[11,12]

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[8] See FCC(2011) for the FCC order describing the FCC's analysis of the transaction and both Baker (2011) and Rogerson (2014) for additional discussion.

[9]See DOJ (2017) and Shapiro (2018). The District Court rejected the DOJ case and approved the merger *(U. S. v. AT&T et. al.,* 2018a) and its decision was upheld on appeal (*U. S. v. AT&T et. al.,* 2019). However, there is considerable controversy over the District Court decision and whether it will affect the manner is which the BLR theory is evaluated in future cases. For further discussion see Caffara *et. al.* (2018), Rogerson (2018), Salop (2019) and *U. S. v. AT&T Inc. et. al.* (2018b, c).

[10]These include the MEO/GMC merger, reviewed by Portuguese antitrust authorities in 2017 (Codhina *et. al.* 2018, OECD 2019, Rodrigues 2019), and the Liberty Global/Corelio/W&W/De Vijver Media merger, reviewed by the European Commission, in 2015 (European Commission DG 2015). The former merger was withdrawn by the merging parties after antitrust authorities expressed their concerns in written filings. The latter merger was approved with conditions intended to limit the competitive harm. The BLR theory was also adopted by Canadian antitrust authorities when they reviewed the Bell Canada/Astral merger in 2012 (Competition Bureau Canada 2012), although the publicly-available material is too limited to determine if Canadian antitrust authorities calculated the $vGUPPI_{BLR}$ in their analysis. This merger was approved subject to significant divestitures and other conditions.

[11]Bargaining theory has also played a role in the evaluation of horizontal mergers. For examples in the health care industry see Nevo (2014), Gowrisankaran *et. al.* (2015), Ho and Lee (2017), *U. S. et. al. v. Anthem, Inc., and Cigna, Corp.* (2017), and Dafny *et. al.* (2019), and in the case of the Comcast/Time Warner Cable merger, see Rogerson 2019.

[12]For example, the health care industry (involving the merger of an insurer, the downstream firm, and a hospital system or other health care provider, the upstream firm) would be a natural industry in which to apply the theory. See Cuestra *et. al.* (2019) for an empirical paper estimating

There is one final issue to highlight regarding the interpretation of the RRC and BLR effects, and how they enter into the analysis of the welfare effects of vertical mergers. A vertical merger between an upstream firm and a downstream firm places the new vertically-integrated firm in charge of negotiating input pricing agreements with downstream rivals and choosing the downstream price charged by its own downstream affiliate. The vertical merger therefore has two different direct impacts on prices, one on the input pricing agreements it negotiates with rivals, and one on the downstream price it chooses for its own downstream affiliate. The RRC and BLR effects only concern the direct effect of the merger on input pricing agreements negotiated with rivals. They do not take account of the direct effect of the merger on the downstream price that the vertically-integrated firm sets for its own downstream affiliate. The vertically-integrated firm also has an incentive to reduce this price to eliminate the double mark-up created by the wholesale price. This is commonly referred to as the Elimination of Double Marginalization (EDM) effect (Kwoka and Slade 2019). The RRC/BLR effects[13] create upward pricing pressure on input prices, which in turn create indirect upward pricing pressure on downstream prices, which harms consumers. However the EDM effect directly creates downward pricing pressure on the downstream price set by the affiliated downstream firm and indirectly creates downward pricing pressure on the downstream prices charged by rivals, which benefits consumers. Furthermore the two effects interact with one another in the sense that changes in input pricing arrangements induced by the RRC/BLR effects influence the downstream price that the vertically-integrated firm chooses, and changes in the downstream price that the vertically-integrated firm chooses influence the input pricing agreements that it negotiates with rival firms. Therefore a full assessment of the welfare impact of a vertical merger requires one to assess the net impact of both direct effects in a single model.

The formulas for calculating the upward pricing pressure on input prices caused by a vertical merger and for determining whether a vertical merger will result in foreclosure presented in this paper are partial equilibrium measures that calculate the direct effect of a vertical merger on input prices ignoring the EDM effect and equilibrium feedback effects.[14] More specifically, the formulas calculate the impact of a vertical merger on the negotiated agreement between the newly-integrated upstream firm and rival downstream firms, holding all downstream prices fixed. In reality, downstream prices will change both due to the EDM effect and equilibrium feedback effects. Thus, while the formulas are useful in providing some insight into the factors that determine the magnitude of the upward pricing pressure on input prices that a vertical merger will generate and whether the upward pricing pressure will be severe enough to result in complete foreclosure, they do not provide a final answer to the question of whether the net effect

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the welfare impact of vertical mergers between hospitals and insurers.

[13]As discussed above, whether one or both of these effects exist depends on the assumptions of the model regarding the distribution of bargaining power between the upstream and downstream firms and the timing of pricing decisions of the model.

[14]The measure of upward pricing pressure measure created by Moresi and Salop (2012) using the RRC model is also a partial equilibrium measure.

of the merger on consumers will be positive or negative when the effects of EDM are also taken into account. Their compensating virtue, of course, is that the formulas are remarkably simple and intuitive and require much less data than would be required to conduct a full-blown simulation. The issue of whether and how one can assess the net effect of a vertical merger will be returned to in Section 5.

The paper is organized as follows. Section 2 presents the formula for calculating the $vGUPPI_{BLR}$ and provides an intuitive interpretation of the formula. Section 3 illustrates how the formula was used to estimate the impact of the Comcast/NBCU merger on the license fees charged by NBCU to rival video distributors. Section 4 presents the formal model and derives both the formula for calculating the $vGUPPI_{BLR}$ and the formula that determines whether the merger will result in complete foreclosure of rivals. Section 5 discusses the issue of incorporating the effects of EDM into the analysis and section 6 discusses how the results might change if upstream prices were set before downstream prices. Finally, section 7 concludes.

2. The $vGUPPI_{BLR}$ Formula

Before getting into the formal details, this section presents the formula for calculating the $vGUPPI_{BLR}$ and provides intuition for the formula.

Suppose that an upstream video programmer licenses a TV channel or group of TV channels to multiple competing downstream video distributors by entering into contracts with each downstream distributor that specify a per-subscriber license fee that the video distributor must pay to the programmer for each subscriber who receives the programming.[15] The upstream firm engages in Nash bargaining with each downstream firm to determine the input prices, where $\theta \in [0,1]$ denotes the seller's bargaining strength. The downstream firms choose downstream prices. Assume that all prices (upstream and downstream) are determined simultaneously. (Formally, this last assumption means that firms negotiating upstream prices view downstream prices as fixed and that firms choosing downstream prices similarly view upstream prices as fixed.) Now suppose that the video programmer proposes to merge with one of the video distributors (which will be referred to as the affiliated distributor). Assume that the resulting vertically-integrated firm continues to engage in Nash bargaining with each downstream rival and the merger does not change the vertically-integrated firm's bargaining strength, θ, in its negotiations. Finally, assume that the vertically-integrated firm's objective, both when it negotiates with rival downstream firms and when it sets the downstream price charged by its own affiliate, is to maximize its total profit across both divisions.

Consider any particular rival downstream distributor. Let $vGUPPI_{BLR}$ denote the predicted increase in the per-subscriber license fee that will be charged to the rival downstream

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[15]Discussion of the role that various assumptions play in the analysis (such as the assumption that input prices are linear) is provided in Section 4 when presenting the formal model.

distributor. The formula for calculating $vGUPPI_{BLR}$[16] is

$$vGUPPI_{BLR} = (1-\theta)\ vd\pi. \tag{1}$$

Recall that $\theta \in [0,1]$ is the Nash bargaining strength of the input supplier in negotiations with downstream firms. The other variables are defined as follows:

π, the profit margin of the affiliated downstream firm (the profit that it earns on one unit of the downstream product)

d, the departure rate (the share of the rival downstream firm's customers that would leave it if it does not include the upstream firm's programming in its bundle of programming)

v, the diversion rate (the share of the customers departing from the rival that will shift to the affiliated downstream firm)

The intuition for the formula is simple. A vertical merger increases the opportunity cost to the vertically-integrated firm of providing the input to a rival, because it now takes into account the profit that its affiliated downstream firm would earn were the input withheld from the rival. To calculate the increase in the negotiated price we therefore need to determine:

(i) the forgone profit per subscriber of the affiliated downstream firm, which is the cost increase of serving the rival induced by the vertical merger

(ii) the share of this cost increase that is passed through in the bargaining game.

This is easy to do.

First consider calculating the forgone profit of the affiliated downstream firm. If the seller withholds input from the rival, the affiliated downstream firm will earn extra profit to the extent that some of the rival's customers switch to the affiliated downstream firm, now that the vertically-integrated firm's programming is no longer available from the rival. When input is withheld, a share d of the rival's customers leave and a share v of these departing customers shift to the affiliated downstream firm. The profit that the affiliated downstream firm earns on a new customer is π. The additional cost per subscriber is the product of these three terms, $vd\pi$.

Now consider the share of the cost increase that is passed through. Since the buyer and seller take downstream prices as fixed when they bargain, they are bargaining over the sale of a fixed number of units of the good. Nash bargaining is extremely simple in this case, since the total surplus created by the exchange does not depend on the negotiated input price. When C denotes the cost per unit of the seller, B denotes the benefit per unit of the buyer and θ denotes the bargaining strength of the seller, trade will occur if and only if it is efficient in the sense that

[16] As originally derived by Murphy (2010a) and Rogerson (2010a).

$B \geq C$. In this instance, the negotiated price per unit of the good being sold is

$$P = (1-\theta)C + \theta B. \quad (2)$$

Therefore, in this type of Nash bargaining, the pass-through rate for increases in the cost of production is $(1-\theta)$, so long as the cost increase does not cause the cost to the seller to rise above the benefit to the buyer.

Putting these two steps together yields the formula in equation (1). That is, the predicted increase is equal to the share $(1-\theta)$ of the increase in opportunity cost induced by the merger, $vd\pi$. While this derivation captures the essential underlying logic driving the BLR effect, it glosses over some details. Furthermore, by not explicitly describing all of the equilibrium conditions, it obscures the fact that the $vGUPPI_{BLR}$ provides only a "partial equilibrium" measure of the effect of the vertical merger. Specifically, it ignores the fact that a vertical merger will also change the equilibrium condition determining the downstream price charged by the vertically-integrated firm, in addition to changing the equilibrium conditions determining the input prices charged to rivals. Section 4 provides a more formal analysis that provides this extra clarity and also derives an additional formula that determines whether or not the merger will result in complete foreclosure. (This occurs if the cost increase induced by the vertical merger is so large that C exceeds B, in which case trade no longer occurs.)

Before turning to the formal analysis, the next section provides an example of how the $vGUPPI_{BLR}$ formula was applied in the evaluation of a particular merger.

3. The Comcast/NBCU Merger: Application of the $vGUPPI_{BLR}$ Formula

To illustrate the formula's application, this section describes the approximate values of various parameters used by the FCC in its analysis of the Comcast/NBCU transaction and the manner in which the FCC determined these values, based on the account given in Rogerson (2014).[17] The FCC separately estimated the likely increase that would occur in the license fee that NBCU charged for its block of national cable networks and the likely increase that would occur in the retransmission consent fee that NBCU charged for retransmission of the local NBCU broadcast signal in each local market where NBCU owned and operated the NBCU affiliate. This section will describe the manner in which the FCC estimated the likely increase in the license fee that NBCU charged distributors for its block of national cable networks.[18]

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[17]See Rogerson (2014) for more details, or the FCC order itself (FCC 2011) for a complete description of the FCC's analysis. Also, see Baker (2011).

[18]Although some parameters, such as Comcast's profit margin, were the same for all calculations, other parameters such as the departure rate and diversion rate varied between calculations. The estimated increases in retransmission consent fees were generally somewhat larger than the estimated increase in the license fee for NBCU's national cable networks. Comcast generally was the dominant incumbent cable provider in local markets where it owned the NBC broadcast station, and its market share in these local markets was therefore generally

First consider the bargaining power parameter, θ. In a market like that for video programming, where there are a few large powerful players on each side of the market, it might be natural to use a value of θ = ½ in the absence of any better information. For example, DOJ made this argument in the AT&T/TW case.[19] However, it may often be possible to estimate the values of θ that actually governed historic transactions in an industry by estimating how surplus was split in these historic agreements. In the case of national cable networks, Crawford and Yurukoglu (2012) have developed such an estimate using a state-of-the-art structural model, and concluded that the value of θ appeared to be very close to ½ in this industry. Citing this study, the FCC concluded that an estimate of θ = ½ was reasonable.

Now consider the profit margin, π, that a downstream distributor earns on a video subscriber. Comcast submitted data on its actual profit margin that the FCC used to determine the value of π. While this data was confidential and the FCC never publicly revealed its profit margin estimate, Rogerson (2014) cites a publicly-available estimate that Comcast earned about $43 per video subscriber at that time, and this is likely close to the value used by the FCC. As Rogerson (2014) notes, this estimate is conservative because it only includes the profit margin earned on video services and does not take into account the fact that many subscribers who switch video service will also switch their broadband and/or wireline telephone service, which will yield additional profit. Taking this additional profit into account could increase the profit margin considerably.

Now consider the departure rate, d. The FCC used data on actual departure rates that had occurred when programming was temporarily withdrawn during disputes over license fees to estimate the departure rate. Once again, most data was confidential and the value used by the FCC was never revealed. However, based on publicly-available data, Rogerson (2014) suggests that a departure rate of .05 (i.e., 5% of a rival's subscribers would leave it if it lost carriage of the NBCU national cable networks) was a conservative estimate that was likely close to the value used by the FCC.

Finally, consider the diversion rate, v. The assumption that departing customers will distribute themselves among alternative distributors in proportion to their relative market shares is the natural starting point for any estimate of diversion rates. Comcast argued that this method of estimating a diversion rate would yield too high an estimate when used to calculate license fee increases that Comcast would charge to a direct broadcast satellite (DBS) provider. This was because there were two DBS providers in the market (DirecTV and DISH), and customers leaving one DBS provider due to the unavailability of NBCU programming would likely view the other DBS provider as the closest substitute to their original provider.[20] The FCC publicly

much higher than its national market share. This generated larger diversion rates which in turn generated larger estimated price increases.

[19] Shapiro (2018), page 41.

[20] The same type of argument might suggest that the diversion rate between a telephone company providing pay-TV service and Comcast would be higher than relative market shares would

stated that it reduced the diversion rate calculated using market shares by some amount to reflect this concern, but did not publicly reveal this amount. Rogerson (2014) suggests using half the diversion rate implied by the market share calculation as a reasonable estimate of the value the FCC likely used. This yields a value of .13. (i.e., 13% of customers leaving a rival because of the absence of NBCU programming would switch to Comcast.)

Plugging the above estimates into formula (1) yields a value of $.14 per subscriber per month. At that time, the license fee that NBCU charged distributors for the bundle of NBCU cable networks was approximately $1.56 per subscriber per month. Therefore, an increase of $.14 would amount to approximately a 9% increase in license fees.

This example demonstrates two points. First, it shows that data was generally available for government authorities to attempt to estimate the relevant parameter values. Second, it shows that at least for the case of the video programming and distribution industry, even conservative estimates of the relevant parameters can yield relatively significant estimated price increases. A key driver of this latter result is, of course, the fact that profit margins are extremely high in the video distribution industry because of the need for revenues to cover the massive sunk costs of the physical infrastructure required to deliver video services.

4. The Formal Model: Deriving the Formulas for $vGUPPI_{BLR}$ and for Determining Whether or Not Foreclosure Will Occur

Assume that a single upstream video programmer, U, produces a cable network that two competing downstream video distributors, D1 and D2, can include in the bundle of video programming that they distribute to their subscribers if they succeed in negotiating a license fee with the upstream firm. The goal of the analysis is to compare the equilibrium outcome when all three firms are separately owned with the outcome in which U and D1 merge to form the vertically-integrated firm V.

The assumption that there is only one upstream firm significantly simplifies the analysis because competitive interactions among rival upstream firms can be ignored. The model simply takes as given the fact that the downstream video distributors have exogenously fixed arrangements in place to license video programming from other programmers besides U.

The assumption that there are only two downstream firms also simplifies the analysis. If there are more than two downstream firms, then more than one rival will remain after the merger. The analysis of this paper can still be conducted for any particular downstream rival, assuming that other downstream firms continue to receive the input and holding their downstream prices

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suggest. This would imply that the diversion rate should be adjusted upwards to calculate the likely impact of the merger of programming prices charged to telephone companies. However, the FCC conservatively adjusted the diversion rate downwards even for purposes of calculating the increases in license fees that NBCU would charge to telephone companies providing pay-TV service.

fixed. This yields a predicted outcome for the supply agreement with each downstream rival, and this is how the formula has been used in practice. This one-by-one analysis is not perfectly correct because it ignores equilibrium feedback effects between the individual bargaining problems. So long as the one-by-one analysis concludes that the vertically-integrated firm will continue to supply all rivals, my own sense is that the problem created by ignoring equilibrium feedback effects between bargaining problems will be minimal.[21]

Assume that each distributor offers a single bundle of programming to its subscribers. Let p_i denote the price that downstream firm i charges for this bundle of programming. Let $q_i(p_1, p_2)$ denote the demand for firm i's service given prices p_1 and p_2 if both firms include U's cable network in their bundle of programming. Let $q_i^+(p_1, p_2)$ denote the demand for firm i's service given prices p_1 and p_2 if only firm i includes the cable network in its bundle of programming, and let $q_i^-(p_1, p_2)$ denote the demand for firm i's service given prices p_1 and p_2 if firm i does not include the cable network in its bundle of programming, but its rival does. Assume that if the upstream firm agrees to license its network to a downstream firm, it does so under a linear pricing arrangement. That is, a licensing agreement between U and Di specifies a per-subscriber license fee, w_i, so that the payment that Di owes U if it includes the network in its bundle of programming is equal to w_i multiplied by the number of subscribers who purchase Di's bundle of programming.[22] Assume that each firm has a constant marginal cost of production in addition to the cost of purchasing the input from U of $c_i \in [0, \infty)$. Finally, to simplify the notation, assume that the upstream firm has zero costs of production.

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[21]As will be discussed in more detail below, when there are only two downstream firms, the $vGUPPI_{BLR}$ is already being calculated holding the two firms' downstream prices fixed. If there are additional firms, holding these firms' downstream prices fixed is completely consistent with the spirit of the analysis. The remaining issue when we add additional downstream firms is whether or not it is reasonable to assume that the vertically-integrated firm will continue to make the input available to them. If the one-by-one analysis concludes that the vertically-integrated firm will continue to supply all rivals, then this provides some assurance that this is a reasonable assumption. (Of course it still might be the case that foreclosing on any individual rival is not profitable, but simultaneously foreclosing on multiple rivals is profitable. One could also check for this.) In the cases where the BLR theory of harm has actually been used in practice, government authorities were primarily concerned with the possibility that the vertical merger would result in input price increases to all rivals rather than with the possibility that any rival or group of rivals would be completely foreclosed. Therefore there is some reason to believe that taking account of externalities between bargaining problems may not have been that important in the cases where the BLR theory has actually been used. However, this is obviously an interesting subject for further research and could potentially be an important issue to consider in actual cases, particularly cases where there is a concern that a vertical merger may result in foreclosure of some or all rivals.

[22]Restricting firms to linear pricing arrangements is a key driver of the results the entire RRC literature. At least in the video programming and distribution industry it appears that pricing arrangements are in fact generally linear.

To complete the description of the model, it is necessary to describe how upstream and downstream prices are determined and the timing of the determination of these prices. The model makes the following three assumptions.

(i) Downstream firms simultaneously choose downstream prices.

(ii) Upstream prices are determined by simultaneous Nash bargaining between the upstream and downstream firm. The upstream firm's Nash bargaining strength is equal to some value $\theta \in [0,1]$ which is unaffected by the merger.

(iii) Upstream and downstream prices are determined simultaneously.

Both the traditional RRC model and the BLR model of this paper adopt assumption (i). As discussed in the introduction, the original RRC model restricts itself to the case where the upstream firm has all of the bargaining power, which corresponds to setting θ equal to 1 in assumption (ii), and it replaces assumption (iii) with the assumption that upstream prices are set before downstream prices. In the resulting model, there is a RRC effect because the upstream firm takes the effect of input prices on downstream prices into account when it sets input prices. However, there is no BLR effect; the BLR effect occurs because a vertical merger affects the upstream firm's threat point, but its threat point is irrelevant to determining the price of exchange when it has all of the bargaining power. Generalizing the simple RRC model to allow for bargaining power to be split between the upstream and downstream firm, while maintaining the assumption that upstream prices are set before downstream prices, produces a relatively complex model with both RRC and BLR effects. Replacing the assumption that upstream prices are determined before downstream prices with assumption (iii), that these prices are determined simultaneously, dramatically simplifies the model by simplifying the nature of Nash bargaining. Furthermore, there is no RRC effect under assumption (iii) because the upstream firm no longer takes the effect of upstream prices on downstream outcomes into account when negotiating input prices. Thus the only effect being measured in this model is the BLR effect.

One can justify the assumption that input and output prices are set simultaneously in different ways. Most simply, one can argue that even if the assumption is not completely correct, it is a useful simplification that sheds significant light on the issue of what economic factors affect the magnitude of the BLR effect. However, it can also be argued that which modeling assumption better predicts actual outcomes is an empirical issue that cannot be settled by theoretical arguments alone for four different reasons.

First, while it is convenient to describe the alternate assumption as being an alternate timing assumption, for purposes of interpreting the assumption and assessing whether or not it captures real world behavior, it is important to recognize that it can also be thought of as an assumption that parties negotiating upstream prices simply do not take the impact on downstream prices into account when they negotiate upstream prices. Whether and to what extent firms in the real world, which have limited information and face costs of gathering and analyzing information, account for such effects is an empirical issue. As will be argued below, these effects may be small in some situations, in which case it would be particularly plausible that firms may choose not to devote extensive resources to predicting or taking account of them.

Second, it seems likely that even if downstream prices ultimately adjust to changes in upstream prices, this will occur with a lag that could significantly reduce the financial impact of such changes. To the extent that changes in future downstream prices become less financially relevant, a model that ignores such these changes will become more accurate, even if firms take account of these small changes.

Third, the assumption that firms negotiating upstream prices ignore the effects of changes in upstream prices on downstream prices may be particularly reasonable in industries where the price charged by any particular upstream firm is small relative to the price of the downstream product that incorporates the input. When this property holds, even a relatively large percentage change in the price of an upstream good will result in a relatively small percentage change in the price of the downstream product, even if the entire upstream price increase is passed through to the downstream price. This means that changes in upstream prices will only have a small impact on downstream prices, which has two implications. First, a model which assumes that firms ignore these effects may still be relatively accurate even if firms do take account of these effects. Second, firms will also be more likely to simply ignore these effects to the extent that they become less significant, so the assumption that firms ignore these effects becomes more plausible. This is an important point because this condition is satisfied by the video programming and distribution industry, which is the primary industry in which the BLR theory of harm has been applied. In this industry, pay-TV providers group the channels produced by individual upstream programmers into large bundles that they offer to their subscribers, rather than selling access to individually priced channels. Furthermore, prices in the video distribution industry are far above the marginal cost of purchasing programming in order to recover the significant physical infrastructure costs associated with video distribution. For both of these reasons, the payment a pay-TV provider makes to any individual programmer is a relatively small share of the total price that a pay-TV provider charges for the entire bundle of channels that it sells to subscribers.[23]

Fourth, the assumption that Nash bargaining predicts actual outcomes becomes more tenuous as we shift from a model where firms take downstream prices as given to one where firms predict how input prices will affect downstream prices. In the former case, the total surplus produced by the bargain remains constant as input prices change, and the Nash bargaining assumption simply determines how parties split a fixed amount of surplus. In this case, Nash bargaining theory simply predicts that the share of surplus received by each party will stay

[23]However, the situation might be quite different in an industry where the downstream firm acts as a retailer of upstream firms' products and makes each product available on a stand-alone basis and when the mark-up of retail price over wholesale price is extremely small. It might be less reasonable in such a situation to assume that firms negotiating upstream prices ignore the effects of changes in upstream prices on downstream prices, although, once again, this is ultimately an empirical issue.

constant as threat points shift. However, in the latter case, the total surplus produced by the bargain changes as the input price changes. Then Nash bargaining determines not only how parties split the amount of surplus that is produced, but also how much surplus is produced. Even if Nash bargaining did a reasonable job of predicting behavior in the simple environment where surplus is fixed, it might not do a good job of predicting behavior in more complex environments where surplus varies. Thus, even in an industry where we believe that changes in upstream prices significantly affect downstream prices and firms account for these effects, it is not necessarily clear which assumption will better predict actual outcomes. That is, it may still be the case that a model using the Nash bargaining solution under the assumption that firms do not take account of the manner in which changes in upstream prices affect downstream prices will predict behavior better than a model using the Nash bargaining solution under the assumption that firms do take account of these effects.

The conditions determining equilibrium can now be described. First consider the case of no vertical integration. Since the formal analysis will only consider the case where U sells to both downstream firms before the merger, equilibrium only needs to be defined for this case. A no-foreclosure equilibrium before the merger is a four-tuple of prices (w_1, w_2, p_1, p_2) satisfying four conditions. First, taking (w_2, p_1, p_2) as given, trade between U and D1 must be efficient (in the sense that the joint profit of U and D1 is weakly higher if D1 includes U's programming in its bundle of programming than if it does not) and that w_1 is a solution to the Nash bargaining problem between U and D1. Second, taking (w_1, p_1, p_2) as given, trade between U and D2 must be efficient (in the sense that the joint profit of U and D2 is weakly higher if D2 includes U's programming in its bundle of programming than if it does not) and that w_2 is a solution to the Nash bargaining problem between U and D2. The third and fourth conditions are that each downstream firm's choice of price must be a best response to its downstream rival's choice of price, so that the downstream prices are a Nash equilibrium to the downstream game given w_1 and w_2.

Now consider the case where U and D1 merge to form the vertically-integrated firm V. We now need to define both a no-foreclosure equilibrium (where V continues to sell the input to D2) and a foreclosure equilibrium (where V does not sell the input to D2), since either type of equilibrium may potentially occur. Formally, a no-foreclosure equilibrium after the merger is a three-tuple of prices (w_2, p_1, p_2) satisfying three conditions. First, taking (p_1, p_2) as given, trade between V and D2 must be efficient (in the sense that the joint profit of V and D2 is weakly higher if D2 includes V's programming in its bundle of programming than if it does not) and w_2 must be a solution to the Nash bargaining problem between V and D2. The second and third conditions are that each downstream price must be a best response to its rival's price, so that the pair of downstream prices are a Nash equilibrium taking w_2 as given. A foreclosure equilibrium after the merger is a pair of prices (p_1, p_2) that satisfies three conditions. First, no trade between V and D2 must be efficient (in the sense that V and D2's joint profit is weakly higher if D2 does not include V's programming in its bundle of programming than if it does), taking p_1 and p_2 as given. The second and third conditions are that the downstream prices must be mutual best responses so that the two downstream prices are a Nash equilibrium.

As discussed in the introduction, the vertically-integrated firm created by the merger of U and D1 both negotiates the input pricing agreement with D2 and chooses the downstream price set by its downstream affiliate, p_1. Therefore the vertical merger has a direct effect on both of these prices. Upward pricing pressure is created on w_2 due to the BLR effect. Downward pricing pressure is created on p_1 due to the EDM effect. The two effects interact in complex ways with one another (i.e., a change in p_1 affects the value of w_2 that V and D2 negotiate and a change in w_2 affects V's optimal choice of p_1) and there are also equilibrium feedback effects. The $vGUPPI_{BLR}$ and the formula determining whether foreclosure occurs are not meant to be predictions of the ultimate impact of the merger taking both the BLR and EDM effects into account. Rather they are meant to provide measures of the direct impact on the negotiated agreement between U and D2 created by the fact that V replaces U in the negotiations with D2. Their compensating virtue, of course, is that the resulting formulas are simple and intuitive, and require less data than would be needed for a full-blown simulation.

In particular, the $vGUPPI_{BLR}$ and the formula determining whether foreclosure will occur are based on determining how the vertical merger will change the negotiated agreement between V and D2, *holding downstream prices fixed at their pre-merger values of p_1* and p_2*.* This is only a partial equilibrium assessment of the impact of vertical integration on the equilibrium outcome because it takes existing downstream prices as given. Downstream prices will actually change in the new equilibrium due to both the EDM effect and equilibrium feedback effects.

Let $(w_1^*, w_2^*, p_1^*, p_2^*)$ denote the pre-merger equilibrium. The goal is to determine the nature of the input pricing agreement negotiated between V and D2 after the merger holding downstream prices fixed at (p_1^*, p_2^*). We wish to determine whether V will still sell the input to D2 after the merger, and, if so, how the negotiated input price will change. Define the $vGUPPI_{BLR}$ to be the increase in w_2 that occurs when V continues to sell the input to D2 after the merger.

We begin by formally defining departure rates, diversion rates, and profit margins. Let $d_i(p_1, p_2)$ denote the departure rate for firm i given prices p_1 and p_2. This is the share of Di's customers that would leave it if it does not carry U's programming but its rival does. Let $v_{i\to j}(p_1, p_2)$ denote the diversion rate from firm i to firm j given prices p_1 and p_2. This is the share of Di's departing customers that would switch to the rival firm. Finally, let $\pi_i(p_i, w_i)$ denote Di's profit margin given p_i. This is the profit that firm Di earns per subscriber. These are formally defined as follows:

$$d_i(p_1, p_2) = \{q_i(p_1, p_2) - q_i^-(p_1, p_2)\}/q_i(p_1, p_2) \quad (3)$$

$$v_{i\to j}(p_1, p_2) = \{q_j^+(p_1, p_2) - q_j(p_1, p_2)\}/\{q_i(p_1, p_2) - q_i^-(p_1, p_2)\} \quad (4)$$

$$\pi_i(p_i, w_i) = p_i - c_i - w_i \quad (5)$$

Let d_i^*, v_i^* and π_i^* denote the values of these measures at the pre-merger equilibrium prices (w_1^* p_1^*, p_2^*). Similarly let q_i^*, q_i^{+*} and q_i^{-*} denote the values of demand evaluated at (p_1^*, p_2^*).

The formal result can now be stated and the proof is given in an Appendix.

Proposition 1:

Suppose that (w_1*, w_2*, p_1*, p_2*) is an equilibrium before the vertical merger. Now suppose that the vertical merger occurs and downstream prices remain fixed at (p_1*, p_2*). Then V will continue to sell the input to D2 after the merger if and only if

$$(p_1^* - c_1)\, v_{2\to1}^* \leq (p_2^* - c_2). \qquad (6)$$

If condition (6) is satisfied, so that the input continues to be sold to D2 after the merger, the amount that the input price will increase by is

$$vGUPPI_{BLR} \quad = \quad (1-\theta)v_{2\to1}^* d_2^*\, \pi_1^*. \qquad (7)$$

The basic approach to proving the result and the specific intuition explaining the formula for the $vGUPPI_{BLR}$ as given by equation (7) has already been provided in section 2, so will only briefly be repeated here. The vertically-integrated firm's opportunity cost of providing programming to D2 increases because it views the extra profit that its own affiliate would earn if it withheld programming from D2 as a new opportunity cost. The extra cost to V of providing programming to one subscriber of D2 is the probability that the subscriber would leave if programming was withheld, d_2*, multiplied by the probability that the departing customer would switch to D1, $v_{2\to1}$*, multiplied by the profit that D1 would earn on that subscriber, π_1*. The Nash bargaining model predicts that (1-θ) of this cost increase will be passed through so long as V's cost of producing the input remains below D2's benefit from receiving the input. This explains the formula for calculating the $vGUPPI_{BLR}$ in equation (7).

Section 2 did not present the formula that determines whether V will continue to provide the input to D2. However, its explanation follows fairly immediately. Equation (6) is the condition guaranteeing that the cost to V of producing the input remains below the benefit to D2 of receiving the input. The benefit to D2 is that it sells more output and it earns an additional profit of (p_2* - c_2) on each additional unit sold. This is the right hand side of equation (6). The cost to V of providing the input is that each additional unit of output sold by D2 results in D1 selling $v_{2\to1}$* fewer units of output. V earns a profit of (p_1* - c_1) per unit of output. Therefore, the cost that V incurs when D2 sells an additional unit of output is $v_{2\to1}$*(p_1* - c_1). This is the left-hand side of equation (6).

5. Taking Account of the Elimination of Double Marginalization (EDM) Effect

This section briefly discusses what is known about calculating the full equilibrium impact of a vertical merger when the combined impact of the upward pricing pressure on input prices charged to rival downstream firms created by the BLR and/or RRC effects and the downward pricing pressure on the downstream price charged by the affiliated downstream firm due to the EDM effect are accounted for.[24] This is what we are ultimately interested in when we evaluate

[24]See Slade (2019) for a discussion of related issues.

the welfare impact of a vertical merger.

At the moment it appears that the only method of assessing the full equilibrium impact of a vertical merger, taking both the BLR/RRC effects and the EDM effect into account, is to try to directly estimate demand and cost functions and then conduct a full-blown simulation. A significant problem with this approach is that it can be difficult to determine whether the results of a particular simulation depend crucially on relatively arbitrary functional form assumptions, or follow from more basic underlying properties of the demand system that can be objectively verified. The beauty of the partial equilibrium analysis presented above is that the results depend on specific objectively-measurable parameters of the demand system rather than on arbitrary functional form assumptions. An important subject for future research is to determine whether a more general analysis of factors that determine the magnitude of the full equilibrium impact of a vertical merger can be created that is not tied to specific functional form assumptions for demand curves.

A few papers report the results of simulating vertical mergers given specific functional form assumptions on demand. Lu, Moresi, and Salop (2007) considers the standard RRC model where the upstream firm is assumed to have all of the bargaining power and upstream prices are set before downstream prices. It assumes symmetric linear demand curves and derives closed-form solutions for equilibrium prices pre and post merger. Das Varma and De Stefano (2018) extends Lu Moresi and Salop (2007) by numerically solving examples in which bargaining power is split between the upstream and downstream firm. It considers examples with both linear demand and logit demand and maintains the assumption of Lu Moresi and Salop (2007) that upstream prices are determined before downstream prices. Domenko and Sibley (2019) extends Lu, Moresi and Salop (2007) by numerically solving examples with asymmetric linear demand, again maintaining the assumption that upstream prices are determined before downstream prices. Sheu and Taragin (2017) considers the case that is the primary focus of this paper. It allows bargaining power to be split between the upstream and downstream firm and assumes that upstream and downstream prices are set simultaneously. It numerically solves examples where demand is either logit or downstream competition is governed by a second price auction. Crawford *et. al.* (2018) conducts a sophisticated structural analysis to estimate underlying structural conditions in the video programming and distribution industry (using specific functional form assumptions for demand) and then simulates the impact of vertical mergers in this industry between providers of regional sports networks (RSNs) and video distributors in the estimated model. Its underlying model is similar to the model that is the primary focus of this paper in the sense that it assumes that upstream and downstream prices are set simultaneously. Cuesta *et. al.* (2019) conducts a similar exercise to that of Crawford *et. al.* (2018) to examine the impact of vertical mergers between insurers and hospital systems. It bases its analysis on a model that assumes that input prices are set before output prices. Institutional differences in the health care industry vs. the video programming and distribution industry require significant additional alterations of the model.

These papers collectively show that the net welfare impact of a vertical merger can be positive or negative and that the results hinge sensitively on the specific functional form assumption on demand. Thus, while they clearly support the conclusion that the EDM effect cannot simply be ignored and must be taken into account along with the RRC and/or BLR effects when evaluating the competitive effects of a merger, they also provide support for the concern that the results of simulations may depend on relatively arbitrary functional form assumptions for demand. This highlights the need for additional research to determine if some more general analysis of factors that determine the magnitude of the full equilibrium impact of a vertical merger can be created that is not tied to specific functional form assumptions for demand. At a minimum it might be useful to see the results of simulations over a broader set of examples.

At least two factors may reduce or at least limit the importance of the EDM effect in some circumstances. First, and most obviously, the EDM effect becomes less important when downstream firms have more bargaining power because this reduces the extent to which the upstream firm can raise input prices above marginal cost in the first place. Thus the EDM effect will tend to matter less when downstream firms have a significant share of the bargaining power.[25] Second, a vertically-integrated firm will still continue to view a significant share of the price cost margin that its upstream affiliate imposes on rival downstream firms as an opportunity cost of expanding its own output, which can significantly reduce the magnitude of the EDM effect. When a vertically-integrated firm expands its own output, a share of the new customers it obtains will be customers who shift from a rival downstream firm that also carries the upstream firm's programming. A vertically-integrated firm will view the lost profit of input sales to these rival downstream firms as an opportunity cost of expanding its own output. In general this means that if some fraction α of the new customers of the vertically-integrated firm come from downstream rivals that also carried the programming, then the vertically-integrated firm will still recognize α of the price cost margin it charges rival downstream firms as an opportunity cost of expanding its own production. Thus the output expansion effect of vertical integration due to EDM will be much smaller than if there were no downstream competition and the upstream firm merged with a monopoly downstream provider.[26]

To conclude this section, I describe how the EDM effect was taken into account in the government's evaluation of the Comast/NBCU and AT&T/Time Warner cases. These are the two major cases in the United States in which the primary theory of competitive harm used by the government authorities evaluating the merger was the BLR effect.

When the FCC considered the Comcast/NBCU merger, the merging parties raised the qualitative issue that the EDM effect would have a countervailing impact on consumer welfare.

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[25]Simulation results in Das Varma and De Stefano (2018) show that the welfare impact of a vertical merger on consumers grows more negative as the bargaining power of downstream firms increases, which support this intution.

[26]Rogerson (2010b, 2010c) made this point in submissions to the FCC when it considered the Comast/NBCU transaction. The general point that a vertically-integrated firm will compete less aggressively in the downstream market if it is supplying inputs to rival downstream competitors has been previously recognized by Chen (2001), Sappington (2005) and Sappington and Unel (2005).

However, the merging parties never presented a full simulation quantifying the net welfare impact of the merger when both the BLR effect and the EDM effect were taken into account. Rogerson (2010b, c) argued that the EDM effect was likely to be significantly reduced because, as discussed above, the vertically-integrated firm would still recognize the opportunity cost of lost input sales to rival firms as a cost of expanding its own output. The FCC ultimately concluded that sufficient evidence had not been presented to show that EDM would have a significant countervailing effect.

The DOJ adopted a more proactive stance when it adopted the BLR theory as its primary theory of competitive harm in the AT&T/Time Warner merger, and conducted a simulation to determine the net effect of the vertical transaction on prices and consumer welfare taking both the BLR effect and EDM effect into account. It found that taking EDM into account reduced the harm created by the merger. However, it found that the merger still generated a net consumer harm. It is interesting to note that the method the DOJ used to calculate new equilibrium prices after the merger was not fully correct. The DOJ engaged in a three step procedure to determine the new equilibrium prices:[27]

(i) Holding downstream prices fixed, it calculated the new input prices to rivals negotiated due to the BLR effect. (i.e., this step amounted to calculating the $vGUPPI_{BLR}$).
(ii) Holding rivals' downstream prices fixed and the input prices to rivals fixed, it calculated the net reduction in the vertically-integrated firm's marginal cost of producing output induced by the vertical merger due to the EDM effect.
(iii) It calculated a new vector of equilibrium prices in downstream markets assuming that the vertical merger did not occur, that the input prices paid by rival downstream firms were equal to the values calculated in step (i) and that the marginal cost of the affiliated downstream firm was reduced from its pre-merger level by the reduction in marginal cost calculated in step (ii).

This procedure essentially ignored equilibrium feedback effects and is not equivalent to the fully correct procedure of calculating the new equilibrium conditions determining both upstream and downstream prices and finding a vector of upstream and downstream prices that simultaneously satisfies all of the new conditions. Since the equilibrium feedback effects can be complex it is difficult to say how DOJ's estimate of the consumer harm generated by the merger would have changed had it used the fully correct procedure.

6. The Case Where Upstream Prices are Determined Before Downstream Prices

This paper has focused primarily on the model that assumes that upstream prices are determined simultaneously with downstream prices and argued that this is an interesting and reasonable case to consider. However, it is still obviously of great interest to determine how the results of the analysis would change in the more complex case in which it is assumed that

[27] Shapiro (2018), pages 62-64.

upstream prices are determined before downstream prices. This section offers a few observations on how this alternate timing assumption might affect the nature of the results and questions/issues that could be explored.

In this more complex model there is still be a BLR effect because the vertical merger still increases the disagreement payoff of the vertically-integrated firm, and changes in the disagreement payoff affect the negotiated price so long as the upstream firm does not have all of the bargaining power. However, the BLR effect is likely to be diminished because D2 would likely reduce its price if it lost the programming. This would reduce the number of customers who would leave D2, and thus reduce the extra profit that D1 would earn if the input was withheld from D2. However, there is also now an RRC effect because V takes account of the fact that increasing the price it charges to D2 changes equilibrium prices in the downstream game in a way that increases D1's profits. This adds additional upward pricing pressure. Thus there are two opposing changes in the additional upward pricing pressure created by a vertical merger when we change the timing assumption. The smaller BLR effect reduces the amount of upward pricing pressure on rival input prices. However, the new RRC effect increases the upward pricing pressure. It is therefore not clear if changing the timing assumption results in a net increase or decrease in the upward pricing pressure on input prices created by a vertical merger.

Another interesting question concerns whether and how changing the timing assumption affects the relative importance of the BLR/RRC effects vs the EDM effect in determining the net impact on consumer welfare. One interesting initial step to take might be to use simulations to determine how the timing assumption affects results in a range of examples. None of the papers that conduct simulations of vertical mergers have done this because each individual paper has restricted itself to considering only one of the two timing assumptions.

If we think of a vGUPPI as providing a partial equilibrium measure of the direct upward pricing pressure on rival input prices that ignores the EDM effect, there is still a natural way to define a vGUPPI in the more complex model. We could define the vGUPPI to be the increase that would occur in the input price charged to a rival downstream firm, holding the downstream price charged by the vertically-integrated firm constant, but allowing for the downstream price charged by the rival to vary as the negotiated input price varies. While this thought experiment is simple to describe, it not clear that a simple formula for the vGUPPI would emerge. This is an interesting subject for future research.

Finally, it is also interesting to note that adopting the assumption that upstream prices are determined before downstream prices will complicate efforts to estimate the actual value of the Nash bargaining parameter that applies to a particular industry (based on examining the values of actual negotiated prices before the merger in that industry). Nash bargaining over input prices becomes considerably more complex when the parties take into account how their negotiated input prices affect downstream prices, because the total surplus created by the agreement changes as the agreed upon input price changes. This complicates efforts to infer the value of the Nash bargaining parameter that is implied by historic agreements. It would clearly be inconsistent to assume that prices were determined sequentially for purposes of predicting the outcome of a vertical merger, but to estimate the value of θ based on the assumption that prices are determined simultaneously.

7. Conclusion

In upstream markets characterized by a few large entities on both sides of the transaction, prices are likely to be set by bargaining rather than being unilaterally announced by the seller. When bargaining in upstream markets is taken into account, it turns out that a vertical merger has an new competitive effect on input prices in addition to the raising rivals cost (RRC) effect. This new effect, which this paper refers to as the bargaining leverage over rivals (BLR) effect, is that a vertical merger increases the ability of the vertically-integrated firm to raise input prices to rivals by increasing its disagreement payoff. This increases its bargaining leverage over input prices charged to rival downstream firms. One strong appeal of this theory is that it provides a simple, intuitive formula to measure the upward pricing pressure caused by a vertical merger due to changes in bargaining leverage based on variables whose values can generally be estimated using available data. The theory that a vertical merger increases a vertically-integrated firm's bargaining leverage has been the primary theory of harm that antitrust authorities have focused on in a number of recent important vertical merger cases in the video programming and distribution industry. It seems likely that this theory will continue to play an important role in the evaluation of future vertical mergers in this industry and others.

Appendix
Proof of Proposition #1

The first step is to calculate the equilibrium condition that determines w_2^* as a function of the other three prices before the merger occurs. Take (w_1^*, p_1^*, p_2^*) as given and consider the possibility that U and D2 agree to a price of w_2. U's profit is

$$U(w_2) = w_1^* q_1^* + w_2 q_2^*. \quad (A.1)$$

Since D2 provides U's programming to all of its subscribers, the number of units of input that U provides to D2 is simply equal to D2's output. If U and D2 do not reach an agreement, then U's profit is

$$U_0 = w_1^* q_1^{+*}. \quad (A.2)$$

Therefore, U's incremental profit from trade at w_2 is

$$U(w_2) - U_0 = -w_1^*(q_1^{+*} - q_1^*) + w_2 q_2^*. \quad (A.3)$$

It is more intuitive to think of benefits and costs per unit of input supplied. U's incremental profit per unit of input becomes

$$(U(w_2) - U_0)/q_2^* = -w_1^* v_{2\to1}^* d_2^* + w_2 . \quad (A.4)$$

This expression is intuitive. If U does not provide the input to D2, it will earn more profit from input sales to D1 and this lost profit is the opportunity cost to U of serving D2. If an individual customer of D2 cannot receive U's programming through D2, the probability that the customer will leave D2 is d_2^* and the probability that the customer will switch to D1 is $v_{2\to1}^*$. If this occurs, U will earn an extra w_1^* in profit. Therefore, the per-unit cost to U of serving D2 is $w_1^* v_{2\to1}^* d_2^*$. The expression in equation (A.4) simply states that U's incremental profit from providing one unit of input to D2 is equal to the price it receives, w_2, minus its cost of providing the input, $w_1^* v_{2\to1}^* d_2^*$.

The incremental benefit to D2 of trade with U at the price w_2 can be calculated in a similar fashion. If trade occurs, D2's profit is

$$D(w_2) = (p_2^* - c_2)\, q_2^* - w_2 q_2^*. \quad (A.5)$$

If no trade occurs D2's profit is

$$D_0 = (p_2^* - c_2)\, q_2^{-*}. \quad (A.6)$$

Therefore D2's incremental profit from trade is

$$D(w_2) - D_0 = (p_2^* - c_2)\, (q_2^* - q_2^{-*}) - w_2. \quad (A.7)$$

Therefore D2's incremental profit from trade per unit of input is

$$(D(w_2) - D_0)/q_2^* \quad = \quad (p_2^* - c_2)\, d_2^* - w_2. \tag{A.8}$$

Once again this expression is intuitive. The benefit that D2 receives from purchasing the input is that it sells more output. If a customer of D2 was unable to view U's programming over D2 it would leave with probability d_2^* and D2 would lose profit of $(p_2^* - c_2)$. Therefore, the benefit that D2 receives per unit of input purchased from U is $(p_2^* - c_2)\, d_2^*$. Equation (A.8) simply states that D2's incremental profit from purchasing one unit of input from U is equal to the extra profit it earns, $(p_2^* - c_2)\, d_2^*$, minus the price it pays, w_2.

The joint profit from trade is non-negative if and only if the extra profit that D2 earns per unit of input weakly exceeds the per unit cost to U of providing the input. Thus, trade is profitable if and only if

$$w_1^* v_{2\to 1}^* \leq (p_2^* - c_2). \tag{A.9}$$

Since we are assuming that trade occurs before the merger, this means that condition (A.9) must be satisfied. The Nash bargaining model predicts that w_2^* is then determined by

$$w_2^* \quad = \quad (1-\theta)\, w_1^* v_{2\to 1}^* d_2^* + \theta\, (p_2^* - c_2) d_2^* \tag{A.10}$$

Now suppose that the merger occurs. Consider the possibility that V and D2 agree to trade at a price of w_2. The benefit per unit of input for D2 is still given by equation (A.7). However we need to calculate the cost per unit of input for V. Following the same procedure as above, the cost per unit of input to V is given by

$$(V(w_2) - V_0)/q_2^* \quad = \quad -(p_1^* - c_1) v_{2\to 1}^* d_2^* + w_2 \tag{A.11}$$

Therefore the per unit cost to V of providing input to D2 is equal to $(p_1^* - c_1) v_{2\to 1}^* d_2^*$. Recall that the per unit cost to U of providing input to D2 was equal to $w_1^* v_{2\to 1}^*\, d_2^*$. Thus the variable "$w_1^*$" in the formula for calculating the per unit cost to U is replaced by the variable "$(p_1^* - c_1)$ in the formula for calculating the per unit cost to V. This is very intuitive. In both cases the opportunity cost of selling programming to D2 occurs because demand for D1 will fall. U earns a profit of w_1^* when D1 sells another unit and V earns a profit of $(p_1^* - c_1)$ when D1 makes another sale.

The joint profit from trade is non-negative if and only if the extra profit that D2 earns per unit of input is greater than or equal to the per unit cost to V of providing the input. Thus trade is weakly profitable if and only if

$$(p_1^* - c_1)\, v_{2\to 1}^* \leq (p_2^* - c_2). \tag{A.12}$$

This is equation (6) in Proposition 1. Let w_2^{**} denote the price of exchange if trade occurs. It is given by

$$w_2^{**} = (1-\theta)\ (p_1^* - c_1)\ v_{2\to1}^*\ d_2^* + \theta\ (p_2^* - c_2)\ d_2^*. \tag{A.13}$$

It follows from equations (A.10) and (A.13) that if trade still occurs after the merger, the increase in the input price charged to D2 is given by

$$w_2^{**} - w_2^* = (1-\theta)\ v_{2\to1}^* d_2^*\ \pi_1^*. \tag{A.14}$$

This is the formula for the $vGUPPI_{BLR}$ presented in equation (7) of Proposition 1. QED

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