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Vertical Ownership and Vertical Control

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ABSTRACT

It is well-known that a seller-imposed non-discrimination clause can soften downstream price competition by constraining opportunistic pricing behavior on the part of an upstream monopolist seller. We extend this insight and demonstrate that in the presence of a pivotal (i.e., large) buyer, a buyer-imposed price floor may be an effective means of eliminating the dynamic inconsistency problem typically associated with the upstream seller, as well as a mechanism to better align product selection from the perspective of the pivotal buyer on the part of the seller. A positive level of vertical ownership of the seller provides additional benefits for a pivotal buyer, but “over-insuring” through vertical ownership diminishes the disciplining effect of the buyer-imposed price floor. If vertical ownership by a pivotal buyer is sufficient to directly control the seller, the large buyer extracts all of the surplus from the seller and other buyers.

I Introduction

Coase (1972) recognized that a monopolist seller may encounter a dynamic consistency problem that precludes the capture of full monopoly rents. Simply, expectations of future price-cutting induce a reduction in current demand, as customers choose to wait for a lower price. This insight has spawned a significant literature. Beginning with Salop’s (1986) path-breaking work, a number of authors explored how monopoly sellers can credibly commit by utilizing non-discrimination, or most-favored customer clauses, in their contracts (Holt and Scheffman, 1987; Belton, 1987; Butz, 1990; Hart and Tirole, 1990; Besanko and Lyon, 1993). In short, by committing itself to treat buyers symmetrically, the monopolist precludes price-cutting, and thereby captures the full monopoly rents. On the other hand, McAfee and Schwartz (1994) show while buyers may prefer the lowest marginal price per unit, additional contractual elements (e.g., franchise fees) may make individual contracting preferable to the most-favored buyer provisions. However, DeGraba (1996) demonstrates that most-favored customer clause can provide commitment if buyers can choose their preferred mix of contractual terms. Lyon (1998) provides an excellent overview of the theoretical and empirical literature.

*Adilov: Department of Economics, Cornell University; Alexander: Federal Communications Commission. We are greatly indebted to David Sappington for his many contributions and continuous support.

Our approach in this paper augments the existing literature in at least two ways. In particular, we model the incentives for imposing *buyer-side* most-favored customers clauses, as well as the implications of a positive level of vertical ownership of the seller by the buyer.

More precisely, we explore an industry configuration composed of a monopoly seller and a pivotal buyer, where only the pivotal buyer's commitment to purchase the product can induce the seller to produce. Importantly, once the project has been funded, the buyer is vulnerable to price-cutting by the seller and free-riding by other buyers. This opportunism is particularly acute in environments of private pricing information, since the absence of price transparency diminishes or precludes the effective use of simple discounting on the part of the seller. As Rey and Verge (2003) note, secret negotiations "undermine the manufacturer's commitment power. Indeed, even if the manufacturer contracts simultaneously with all its retailers, each retailer may still worry that its competitors receive secret deals (e.g., lower prices per unit)." In this case, ex-post renegotiation, a standard vertical contracting tool, is likely ineffective. In fact, this price opacity is amplified in settings where the buyers re-sell bundles of goods to final consumers. In this case, the pivotal buyer cannot make useful inferences regarding the price of any single item in the bundle from the final prices charged by competitors.

We suggest that one efficient response to this problem may be the imposition of a most-favored customer contract by the pivotal buyer on the seller, possibly in combination with some degree of vertical ownership on the part of the pivotal buyer. Clearly, the pivotal buyer has strong incentives to contractually bind the monopoly seller, since the seller cannot credibly commit itself to a simpler discounting mechanism.

However, it may also be the case that the most-favored customer contract may not bind, in which case some degree of vertical ownership provides insurance for the pivotal buyer. In fact, given some level of vertical ownership, there are instances in which the pivotal buyer benefits from a relaxation of the most-favored customer clause on the part of the seller. Thus, we envision and model a situation in which the pivotal buyer optimally calibrates the most-favored customer contract and the degree of vertical ownership in a profit maximizing fashion.

The Cable Industry

To motivate the theory, we use the cable television industry as an illustrative case.¹ Of the 102 million households with at least one television, 69 million subscribe to cable television services, which earns programming networks approximately \$9 billion per year in sales of programming to cable operators. In addition to its ubiquity and importance as a consumer service, cable television provides a particularly useful framework, since the supply-side elements of the industry correspond nicely to the characteristics of our model, specifically the presence of pivotal buyers, the ubiquity of most-favored customer contracts,

¹Other industry studies of most-favored customers clauses include pharmaceuticals, turbine generators, natural gas, and legal settlements.

and the incidence of vertical ownership.²

Risky programming assets, combined with uncertain product valuations on the part of smaller buyers, are important features of the cable television industry.³ Importantly, the seller has strong incentives to undertake high-risk high-cost projects, since the pivotal buyer covers the cost. In what follows, we show how a most-favored customer clause can be a mechanism to better align product selection from the perspective of a pivotal buyer on the part of the seller. However, even if a most-favored customer clause fails to align a seller's product selection in a fashion that favors a pivotal buyer, the buyer is compensated via vertical ownership and penalty transfer payments from the seller. Interestingly, vertical ownership may preclude a credible commitment to trigger the most-favored customer penalty clause, in which case vertical ownership may reduce the large buyer's profits.

Notably, risk-sharing via the division of advertising revenue among buyers and sellers is an important characteristic of the cable television industry, since advertising constitutes a significant revenue source for both buyers and sellers.⁴ The level of advertising revenue is closely related to the commercial success of the seller's product, and we show that advertising revenue provides additional incentives for a large buyer to optimally calibrate the level of the most-favored customer clause and vertical ownership. Thus, when a large buyer has some degree of vertical ownership in a seller, the buyer factors in this source of diversification when setting most-favored customer levels. To put a somewhat finer point on it, given an ownership stake in the seller, the large buyer may have an incentive to set a lower most-favored customer level than that set absent an ownership stake. This calibration has important implications for smaller buyers in terms of their capacity to obtain programming, as well as for their resulting profitability.

While we demonstrate that vertical ownership and vertical contracts can increase a large buyer's profits, increases in vertical ownership, in the presence of vertical contracts, might actually decrease a pivotal buyer's profits. This potential decrease in profitability might occur since vertical ownership potentially reduces a large buyer's incentive to use vertical contracts; thus, increases in vertical ownership can diminish the large buyer's credibility in implementing a most-favored customer clause, giving the seller more freedom in programming choice. As we show, in the extreme case, vertical ownership can reduce a large buyer's profits. Moreover, we show that a seller's profits will never decrease due to increasing vertical ownership.

In the model and discussion that follows, we use the term *sellers* to refer to upstream program providers such as Home Box Office, while *buyers* refer to downstream cable operators such as Comcast who distribute programming

²For more on the existence and nature of most-favored customer contracts in the cable industry, see Multi-channel News, February 3, 2003 "Comcast Sizes Up Net Pacts," and CableWorld, June 16, 2003, "YES Cries Foul Over TWC Tier."

³This may be why "system swaps" are relatively frequent in the cable industry. A system swap involves two cable companies swapping comparable systems, ostensibly to gain local economies, but perhaps additionally to have the opportunity to view the contracts and hence prices competitors have payed programmers.

⁴The other source of revenue is subscriber fees.

to final consumers. In addition, we define a most-favored customer clause (hereafter MFN) as a contractual specification such that a program seller contractually commits to giving a large program buyer a per-customer price no higher than that of any other program buyer.⁵

The paper is organized as follows. In Section Two, we introduce our model, detail the stage game, and define the equilibrium. In Section Three, we characterize the optimal choices of the participants, via backward induction. In Section Four, we analyze the implications of vertical ownership and MFN clauses. Finally, we make some concluding remarks.

II The Model

In this section, we present our model. The central focus of our model relates to the division of the bargaining surplus among large program buyers, small program buyers, and program sellers, under varying structural and contractual conditions. More precisely, we structure a stage game in which nature first chooses the products which vary by quality, profitability, and requisite investment level. Next, the seller chooses a product among the projects and makes a proposal to the large buyer, which the large buyer then accepts or rejects. If the large buyer accepts the proposal, the seller then makes a take-it-or-leave-it offer to the small buyer, which the small buyer accepts or rejects. Finally, the value of the game is realized and observed by all parties.

We begin by assuming there is a single program seller, a large program buyer, and a small program buyer. We denote by $\alpha \in [0, 1)$ the large buyer's ownership share in the seller.⁶ The seller has several programming projects. Each project j requires an investment equal to I^j , and the large buyer decides whether to commit to purchasing the project.⁷ The programming project j yields the large buyer revenue of v_H^j if the state is high and v_L^j if the state is low, where $v_H^j > v_L^j \geq 0$. Let $\lambda^j \in (0, 1)$ denote the probability that the state is high for project j . In our model, the value of the program is taken to be uncertain to reflect the actual uncertainties and risks associated with program production.⁸

If the project is undertaken, the large buyer sets a minimum transfer payment level (hereafter, MTP)⁹, T_{min} , to be paid by the small buyer to the seller.

⁵For simplicity, we assume the large buyer chooses the level of transfer payments embedded in the MFN clause, and that there is a penalty if the seller decides to charge a smaller buyer a price below the transfer price specified by large buyer. This penalty transfer price level is not necessarily equal to the per-customer cost of the large buyer, which is reasonable since a large buyer may find it optimal to choose an MFN trigger level below a buyer's per-customer cost. However, this assumption is not crucial to our results.

⁶For the purposes of this paper, we assume vertical ownership does not give large buyers direct control over sellers. Instead, in our model the large buyer affects seller behavior indirectly through market mechanisms.

⁷By assumption, if the large buyer does not commit to purchasing the program, the program will not be produced. For simplicity, we refer to buyers of this type as pivotal. In the cable industry, the emergence of pivotal buyers results from the fact that sellers typically cannot cover their programming costs via outside financing.

⁸One might assume a different distribution of program values. Our choice of the binomial distribution is motivated by computational simplicity.

⁹The minimum transfer payment level denotes the MFN clause trigger point endogenously determined by the

If the seller charges the small buyer a transfer price T below the minimum transfer payment level, the seller must pay a penalty of $p(T_{min} - T)$ to the large buyer, where $p > 0$.¹⁰

The small buyer can be one of two types, high or low, and only the small buyer knows its type. We divide buyers into types to capture uncertainty on the seller's side relating to the level of payments from small buyers. The probability that a small buyer is a high type is given by $\phi \in (0, 1)$. The i -type small buyer values project j at $\gamma_i v_H^j$ if the state is high and $\gamma_i v_L^j$ if the state is low, where $1 > \gamma_H > \gamma_L > 0$. For simplicity, we assume the seller makes a take-it-or-leave-it offer (β, T) to the small buyer, where $\beta \in [0, 1]$ is the share of the revenue $\gamma_i v_i^j$ kept by the small buyer.

The timing of events is as follows:

Stage I: Nature chooses $\gamma_i \in \{\gamma_H, \gamma_L\}$, $\{\lambda^j, I^j, \{v_H^j, v_L^j\}\}_{j=1}^n$.

Stage II: Seller observes $\{\lambda^j, I^j, \{v_H^j, v_L^j\}\}_{j=1}^n$ and chooses $k \in \{1, \dots, n\}$, a project among n mutually exclusive projects.

Stage III: Large buyer observes $\lambda^k, I^k, \{v_H^k, v_L^k\}$ and decides whether to accept or reject seller's proposed project. If the proposed project is accepted, the large buyer chooses a per customer minimum transfer payment level T_{min} .

Stage IV: If the project is accepted at Stage III, the seller, after observing T_{min} , makes a take-it-or-leave-it offer (β, T) to the small buyer.

Stage V: The small buyer observes its type $\gamma_i \in \{\gamma_H, \gamma_L\}$ and accepts or rejects the seller's proposal.

Stage VI: The state for the project (i.e., v_H^j or v_L^j) is realized and observed by all parties.

Next, we define the Nash Equilibrium.

Definition 1: The subgame perfect Nash Equilibrium consists of (1) a large buyer's $action^* \in \{\text{accept}, \text{reject}\}$ and a minimum transfer payment level T_{min}^* ; (2) the seller's project choice $k \in \{1, \dots, n\}$ and offer schedule (β^*, T^*) ; and (3) the small buyer's $action^* \in \{\text{accept}, \text{reject}\}$ such that:

- a. The small buyer's action maximizes, conditional on its type, its expected profits based on the seller's

large buyer.

¹⁰The above assumptions imply a liquidity constraint for the seller such that the sum of the transfer payments has to be greater than or equal to the investment cost, i.e., $I^j + T - \text{penalty} \geq I^j$.

offer schedule.

b. The seller's offer schedule maximizes the seller's profits given the minimum transfer payment level and taking into account the small buyer's optimal behavior in Stage V. In addition, the seller's project choice maximizes the seller's profits conditional on the large buyer's optimal choices in Stage IV, the small buyer's optimal behavior in Stage V, and the seller's own optimal behavior in Stage III.

c. The large buyer's action and minimum transfer payment level maximize the large buyer's profits, taking into account the seller's and the small buyer's optimal behaviors.

III Characterization of the Equilibrium

Stage V

We solve the problem by backward induction. At Stage V, the small buyer knows its own type γ_i . Taking the seller's offer schedule to be (β, T) and seller's project choice to be k , the small buyer accepts the offer if and only if its expected revenue exceeds the transfer payment:

$$\gamma_i \beta (\lambda^k v_H^k + (1 - \lambda^k) v_L^k) - T \geq 0 \quad (1)$$

The small buyer rejects the seller's offer if:

$$T > \gamma_i \beta (\lambda^k v_H^k + (1 - \lambda^k) v_L^k)$$

To simplify the notation in what follows, we denote $v^k \equiv \lambda^k v_H^k + (1 - \lambda^k) v_L^k$.

Stage IV

At Stage IV, the minimum transfer payment level T_{min} is known. Note that the transfer payment charged by the seller must satisfy the seller's liquidity constraint for the project to be undertaken:

$$I^k + T - p(T_{min} - T) \geq I^k$$

or simply

$$T \geq \frac{p}{1+p} T_{min}.$$

If the seller wants its offer to be accepted by at least one type of small buyer, condition (1) must hold for that buyer. Condition (1) should hold with equality in equilibrium since the seller's profits are strictly increasing in T .

This suggests that in a separating equilibrium, where only the high-type small buyers are served, the seller chooses:

$$T^* = \gamma_H \beta^* v^k$$

and in a pooling equilibrium, where both types of small buyers are served, the seller chooses:

$$T^* = \gamma_L \beta^* v^k$$

Stage III

In Stage III the large buyer accepts or rejects the project proposed by the seller and chooses T_{min} if the project is accepted.

The large buyer's decision whether to accept a particular project proposed by the seller is straightforward—the large buyer accepts project k if the large buyer's expected profits are non-negative:

$$v^k + \max\{\phi\gamma_H v^k, \alpha(\phi\gamma_H + (1-\phi)\gamma_L)v^k\} - I^k \geq 0 \quad (2)$$

and rejects project k if the large buyer's expected profits are negative:

$$v^k + \max\{\phi\gamma_H v^k, \alpha(\phi\gamma_H + (1-\phi)\gamma_L)v^k\} - I^k < 0 \quad (3)$$

If the project is accepted, the large buyer then sets T_{min} , which determines whether the equilibrium will be pooling or separating.¹¹

Clearly, the large buyer prefers the pooling equilibrium to the separating equilibrium if $ER(pooling, buyer) \geq ER(separating, buyer)$, i.e.,¹²

$$\alpha(1-\phi)\gamma_L \geq (1-\alpha)\phi\gamma_H \quad (4)$$

The interpretation of (4) is straightforward. The left-hand side of the inequality is the marginal increase in the large buyer's revenue from vertical ownership in the seller (via payments from the low-type small buyer), and the right-hand side of the inequality is the marginal decrease in the large buyer's revenue from not being able to capture all of the high-type small buyer's surplus.

Similarly, the large buyer prefers the separating equilibrium to the pooling equilibrium if:

$$\alpha(1-\phi)\gamma_L \leq (1-\alpha)\phi\gamma_H \quad (5)$$

¹¹The large buyer gets direct revenue from the project, with expected value $\lambda v_H^k + (1-\lambda)v_L^k v^k$. Moreover, there are two additional sources of revenue for the large buyer: potential MTP penalty payments and vertical ownership earnings.

¹²See Appendix Two

Stage II

Consider the seller's choice among I mutually exclusive projects. The seller's profits depend on whether the large buyer chooses the pooling or separating equilibrium. The seller's profits are zero in the separating equilibrium and $(\phi\gamma_H + (1 - \phi)\gamma_L)v^j$ in the pooling equilibrium. Note that the condition under which the large buyer chooses the separating equilibrium over the pooling equilibrium, (4), does not depend on project's characteristics $\lambda^j, v_H^j, v_L^j, I^j$.

Pooling. Suppose that $\alpha(1 - \phi)\gamma_L \geq (1 - \alpha)\phi\gamma_H$. Then, the large buyer prefers the pooling equilibrium to the separating equilibrium. The seller's profits from choosing project j are $(\phi\gamma_H + (1 - \phi)\gamma_L)v^j$, i.e., a multiple of expected revenue $v^j = \lambda^j v_H^j + (1 - \lambda^j)v_L^j$. Thus, the seller chooses the project that has the highest expected revenue. Under these conditions, we characterize the equilibrium strategies:

Stage II: The seller chooses the project k that solves:

$$k = \arg \max_j \{v^j : (1 + \alpha(\phi\gamma_H + (1 - \phi)\gamma_L))v^j - I^j \geq 0\} \quad (6)$$

Stage III: The large buyer accepts the seller's proposal and sets the MTP level at $T_{min} = 0$.

Stage IV: The seller sets $(T, \beta) = (0, 0)$.

Stage V: The small buyer (both high- and low-type) accepts the seller's proposal.

Expected Profits: The expected profits are:

$$E\pi_{seller} = v^k(\phi\gamma_H + (1 - \phi)\gamma_L) \quad (7)$$

$$E\pi_{large\ buyer} = (1 + \alpha(\phi\gamma_H + (1 - \phi)\gamma_L))v^k - I^k \quad (8)$$

$$E\pi_{small\ buyer} = 0 \quad (9)$$

Separating. Suppose $\alpha(1 - \phi)\gamma_L < (1 - \alpha)\phi\gamma_H$. In this case, the large buyer prefers the separating equilibrium to the pooling equilibrium. The seller's profits from choosing project j are zero regardless of the project chosen. In this instance, we assume that the seller chooses the project that maximizes large buyer profits.¹³ Under these conditions, we characterize the equilibrium strategies:

¹³Recalling that the large buyer can refuse to buy the project.

Stage II: The seller chooses the project k that solves:

$$k = \arg \max_j \{(1 + \phi\gamma_H)v^j - I^j \geq 0\} \quad (10)$$

Stage III: The large buyer accepts the seller's proposal and sets the MTP level at $T_{min} \frac{\gamma_H v^k (1+p)}{p}$.

Stage IV: The seller sets $(T, \beta) = (\gamma_H v^k, 1)$.

Stage V: Only the high-type small buyer accepts the seller's proposal.

Expected Profits: Expected profits are:

$$E\pi_{seller} = 0 \quad (11)$$

$$E\pi_{large\ buyer} = (1 + \phi\gamma_H)v^k - I^k \quad (12)$$

$$E\pi_{small\ buyer} = 0 \quad (13)$$

IV Implications

Emergence of the Minimum Transfer Payment

While standard theory suggests that a seller may use a most-favored customer clause as a commitment mechanism, the function of the MTP in our model differs from the conventional framework. Specifically, we have modelled a framework in which a buyer-imposed most-favored customer clause solves the seller's commitment problem and induces the seller to produce projects of greater value to the large buyer.

To illuminate, consider the situation with $T_{min} = 0$, regardless of the project selected by the seller. We have shown that in this case (1) the pooling equilibrium will result and (2) the seller will produce the project with the highest expected revenue, v^j . However, as we have shown, the project with the highest expected revenue does not necessarily maximize the large buyer's surplus (including investment costs). Without the MTP the large buyer is compensated via its vertical ownership share, but cannot induce the seller to choose a particular project.

Now, consider an MTP arrangement with parameter values that result in a separating equilibrium. In this case, the large buyer can induce the seller to choose the project that maximizes the large buyer's surplus since the seller no longer favors the project with the highest expected revenue. Thus, we suggest that MTP arrangements emerge in the cable industry to induce the seller to choose the projects that have the highest net value to the large, pivotal buyer. However, for some set of parameter values, the MTP does not affect the seller's behavior and the pooling equilibrium results. In these cases, the MTP fails to induce the seller to choose the project preferred by the pivotal buyer.

Project Selection and the Social Optimum

It is ambiguous whether the MTP or vertical integration induces the seller to choose the project favored by a social planner. Note that the social planner maximizes total welfare $(1 + \phi\gamma_H + (1 - \phi)\gamma_L)v^k - I^k$, the seller maximizes v^k , and the pivotal buyer maximizes either $(1 + \alpha\phi\gamma_H + \alpha(1 - \phi)\gamma_L)v^k - I^k$ or $(1 + \phi\gamma_H)v^k - I^k$. Thus, both the sellers and the large buyers goals diverge from the goals of a social planner. Therefore, neither vertical ownership nor the MTP can guarantee that the socially optimal project will be chosen. However, as we show in the following example, it is plausible that an MTP, in the absence of vertical ownership, induces the seller to choose the project preferred by the social planner.

Example 1: Suppose $v_H^1 = 20$, $v_L^1 = 0$, $\lambda^1 = \frac{1}{2}$, $I^1 = 2$, $v_H^2 = 40$, $v_L^2 = 0$, $\lambda^2 = \frac{1}{2}$, $I^2 = 18$, $\gamma_H = \frac{1}{2}$, $\gamma_L = \frac{1}{4}$, $\phi = \frac{1}{4}$, $\alpha = 0$, $p = 1$.

First, note that the large buyer prefers the separating equilibrium to the pooling equilibrium since condition (5) holds. Thus, the small buyer's and the seller's profits are zero, and the seller selects the project that maximizes the large buyer's profits.

The large buyer's profits from the first project are $(1 + \frac{1}{4} \cdot \frac{1}{2})(20 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) - 2 = 9\frac{1}{4}$, while the large buyer's profits from the second project are $(1 + \frac{1}{4} \cdot \frac{1}{2})(40 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) - 18 = 4\frac{1}{2}$. Thus, the seller selects the first project.

The large buyer accepts the project and chooses $T_{min} = \frac{\frac{1}{2}(40 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2})(1+1)}{1} = 10$. The seller then chooses the offer schedule $(T, \beta) = (\frac{1}{2}(20 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}), 1) = (5, 1)$, and only the high-type small buyer accepts the project.

The maximum social welfare from project one is $(1 + \frac{1}{4} \cdot \frac{1}{2} + \frac{3}{4} \cdot \frac{1}{4})(20 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) - 2 = 11\frac{1}{8}$. The maximum social welfare from project two is $(1 + \frac{1}{4} \cdot \frac{1}{2} + \frac{3}{4} \cdot \frac{1}{4})(40 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) - 18 = 8\frac{1}{4}$. Thus, the social planner also prefers project one over project two.

The Effect of Vertical Ownership

One important question relating to the cable industry from a regulatory perspective is the effect of vertical ownership on the provision and acquisition of programming. Clearly, for low vertical ownership shares condition (4) is violated while for high vertical ownership shares condition (4) holds. This implies that when vertical ownership increases, the large buyer tends to select the pooling equilibrium over the separating equilibrium. Thus, higher ownership shares increase the large buyer's incentive to serve low-type small buyers.

However, increases in the large buyer's vertical ownership share will not unambiguously increase the large buyer's profits. To see this, recall that

the MTP gives the large buyer an instrument to discipline the seller with respect to product selection. However, as the vertical ownership share of the large buyer increases, the large buyer becomes progressively more reluctant to trigger the MTP, since it involves the sacrifice of profits relating to vertical ownership. Thus, although an increase in vertical ownership increases the large buyer's profits by capturing more of the seller's surplus, the seller's bias toward projects with high expected revenues could in fact decrease the large buyers profits. We illustrate this case in the following extension of Example 1. Note that in Example 1 the large buyer's ownership share was zero. In Example 2, the large buyer's ownership share is positive.

Example 2: Suppose $v_H^1 = 20$, $v_L^1 = 0$, $\lambda^1 = \frac{1}{2}$, $I^1 = 2$, $v_H^2 = 40$, $v_L^2 = 0$, $\lambda^2 = \frac{1}{2}$, $I^2 = 18$, $\gamma_H = \frac{1}{2}$, $\gamma_L = \frac{1}{4}$, $\phi = \frac{1}{4}$, $\alpha = \frac{3}{7}$, $p = 1$.

In this case, the large buyer prefers the pooling equilibrium to the separating equilibrium because condition (4) holds: $\frac{3}{7}(1 - \frac{1}{4})\frac{1}{4} > (1 - \frac{3}{7})\frac{1}{4}\frac{1}{2}$.

The seller's profits from the first project are $(\frac{1}{4} \cdot \frac{1}{2} + \frac{3}{4} \cdot \frac{1}{4})(20 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) = 3\frac{1}{8}$, and $(\frac{1}{4} \cdot \frac{1}{2} + \frac{3}{4} \cdot \frac{1}{4})(40 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) = 6\frac{1}{4}$ from the second project. Thus, the seller selects the second project.

The large buyer accepts the project and chooses $T_{min} = 0$. The seller then chooses the offer schedule $(T, \beta) = (0, 0)$, and both types of small buyers accept the project. The large buyer's profits are $(1 + \frac{3}{7}(\frac{1}{4} \cdot \frac{1}{2} + \frac{3}{4} \cdot \frac{1}{4}))(40 \cdot \frac{1}{2} + 0 \cdot \frac{1}{2}) - 18 = 4\frac{19}{28}$.

Although the large buyer's ownership share in Example 2 is greater than in Example 1, the large buyer's profits are smaller in Example 2 than Example 1, $4\frac{19}{28} < 9\frac{1}{4}$. This reduction in profitability is due to the fact that the large buyers vertical ownership in the seller precludes the large buyer from credibly committing to a high level for the MTP.

We note that varying vertical ownership levels do not affect the small buyer's profits, because either the large buyer or the seller extracts all of the small buyer's surplus. In fact, higher levels of vertical ownership likely increase the seller's profits only, because the larger buyer will be more inclined to choose the pooling equilibrium over the separating equilibrium. Recall that the seller's profits are positive in the pooling equilibrium and zero in the separating equilibrium.

We assume that vertical ownership does not give the large buyer direct control over the seller's decisions, although the large buyer might effect the seller's choices indirectly. However, if vertical ownership does give the large buyer the power to directly circumscribe the seller's behavior, then the large buyer can use vertical ownership to achieve goals that potentially diverge from profit maximization. These goals might include various anti-competitive outcomes depending on market structure, concentration, and buyer-seller specific characteristics.¹⁴ Importantly, if vertical ownership by a pivotal buyer is suf-

¹⁴To incorporate the potentially divergent goals of large buyers, our model can be extended to a dynamic

ficient to directly control the seller's decisions, then the pooling equilibrium will result where the large buyer extracts all of the surplus from the seller and the small buyer.

Discussion

We noted that the seller has an incentive to undertake projects with high expected revenues that do not necessarily maximize either the total surplus or the large buyer's profits.¹⁵ Our hypothesis of a seller's bias toward projects with high expected revenue is consistent with the observation of escalating programming costs in the cable industry. As we have suggested, the introduction of an MTP may induce the seller to choose the projects that are preferred by the large buyer, which suggests that the MTP may emerge as a tool to better align the incentives of the large buyer and the seller. When the MTP fails to alter the seller's choices, the large buyer is compensated via vertical ownership shares in the seller.

The reason why the seller and large buyer prefer different projects is a simple divergence of incentives. Recall that we assume the large pivotal buyer makes a take-it-or-leave-it offer to the seller. Without uncertainty, the large buyer would simply extract all of the seller's surplus - correspondingly, the less uncertain the projects value is, the more surplus the large buyer extracts from the seller.

On the other hand, the more uncertain the projects value, the more variable (i.e., advertising) revenue the seller can potentially extract from smaller buyers. In this case, vertical ownership serves to better align the incentives of the large buyer and the seller. More precisely, the large buyer's goals better align with the sellers.

Conclusion

It is well-known that a seller imposed non-discrimination clause can soften downstream price competition by constraining opportunistic pricing behavior on the part of an upstream monopolist seller. We demonstrated that in the presence of pivotal buyers, a buyer-imposed price floor may be an effective means of eliminating the dynamic inconsistency problem typically associated with the upstream seller, as well as a mechanism to better align product selection from the perspective of the pivotal buyer on the part of the seller. Vertical ownership provides insurance for a pivotal buyer, but "over-insuring" through vertical ownership diminishes the disciplining effect of the MTP.

framework.

¹⁵Assuming there is a positive correlation between revenue and investment.

Appendix One: The Range of Possible Transfer Prices

We determine the four cases relating to the value of T_{min} that exhaust the range of possible transfer prices. Before proceeding, we make the following assumption:

$$\text{Assumption 1: } \phi\left(\frac{\gamma_H}{\gamma_L} - 1\right) < p$$

Assumption 1 implies that, given a sufficiently high penalty, it is not optimal for the seller to charge a price below the minimum transfer price level in the pooling equilibrium.¹⁶

Case 1: $\gamma_L v^k \geq T_{min}$.

(i) In the pooling equilibrium, either $T_{min} \geq T$ or $\gamma_L v^k \geq T \geq T_{min}$. Let $T_{min} \geq T$; then $\beta = \frac{T}{\gamma_L v^k}$. The seller's expected profits are $E\pi_{i, seller} = T - p(T_{min} - T) + \phi(1 - \beta)\gamma_H v^k + (1 - \phi)(1 - \beta)\gamma_L v^k = (\phi\gamma_H + (1 - \phi)\gamma_L)v^k + T(p - \phi(\frac{\gamma_H}{\gamma_L} - 1)) - pT_{min}$. Since $p - \phi(\frac{\gamma_H}{\gamma_L} - 1) > 0$, the maximum $E\pi_{i, seller}$ will be achieved at the highest level of T , T_{min} . So, in this instance, $T_i^* = T_{min}$; $\beta_i^* = \frac{T_{min}}{\gamma_L v^k}$; and $E\pi_{i, seller}^* = (\phi\gamma_H + (1 - \phi)\gamma_L)v^k - T_{min}\phi(\frac{\gamma_H}{\gamma_L} - 1)$.

(ii) Let $\gamma_L v^k \geq T \geq T_{min}$. Then, $\beta = \frac{T}{\gamma_L v^k}$, and the MTP constraint does not bind. The seller's expected profits are $E\pi_{ii, seller} = \phi\gamma_H v^k + (1 - \phi)\gamma_L v^k - T\phi(\frac{\gamma_H}{\gamma_L} - 1)$. Since $\phi(\frac{\gamma_H}{\gamma_L} - 1) > 0$, the seller's profits will be maximized at the lowest level of T . This implies that $T_{ii}^* = T_{min}$; $\beta_{ii}^* = \frac{T_{min}}{\gamma_L v^k}$; and $E\pi_{ii, seller}^* = E\pi_{i, seller}^* = (\phi\gamma_H + (1 - \phi)\gamma_L)v^k - T_{min}\phi(\frac{\gamma_H}{\gamma_L} - 1)$.

Remark: Comparing (i) and (ii), note that the pooling equilibrium when the MTP is not triggered is preferred to the pooling equilibrium when the MTP is triggered.

(iii) In the separating equilibrium only the high-type small buyers are served, and the seller extracts all of the high-type small buyer's surplus. The seller does this by setting: $T_{iii}^* = \gamma_L v^k$; $\beta_{iii}^* = \frac{\gamma_L}{\gamma_H}$; and $E\pi_{iii, seller}^* = \phi\gamma_H v^k$.¹⁷

Remark: The pooling equilibrium dominates the separating equilibrium if $E\pi_{i, seller}^* \geq E\pi_{iii, seller}^*$. If

$$(1 - \phi)\gamma_L v^k \geq T_{min}\phi\left(\frac{\gamma_H}{\gamma_L} - 1\right) \quad (14)$$

¹⁶Assumption 1 is used in subcase i of Case 1.

¹⁷There is more than one schedule of transfer payments that gives rise to the same level of profits.

then the pooling equilibrium results, and the MTP is not binding. If

$$(1 - \phi)\gamma_L v^k \leq T_{min} \phi \left(\frac{\gamma_H}{\gamma_L} - 1 \right) \quad (15)$$

then the separating equilibrium results, and the MTP level is binding.

Case 2: Let $\gamma_H v^k \geq T_{min} \geq \gamma_L v^k \geq \frac{p}{1+p} T_{min}$.

(iv) In the pooling equilibrium, it must be the case that $\gamma_L v^k \geq T \geq \frac{p}{1+p} T_{min}$ for the low-type small buyer to accept the seller's offer. The seller's expected profits are (similar to case (i)):

$$E\pi_{iv, seller}^* = (\phi\gamma_H + (1 - \phi)\gamma_L)v^k + T(p - \phi(\frac{\gamma_H}{\gamma_L} - 1)) - pT_{min}.$$

This implies that $T_{iv}^* = \gamma_L v^k$; $\beta_{iv}^* = 1$; and $E\pi_{iv, seller}^* = \gamma_L v^k - p(T_{min} - \gamma_L v^k)$.

(v) In the separating equilibrium, only the high-type small buyer is served, and the seller extracts all of the high-type small buyer's surplus by setting $T_v^* = \gamma_H v^k$; $\beta_v^* = 1$; and $E\pi_{v, seller}^* = \phi\gamma_H v^k$.

Remark: Clearly, $E\pi_{iv, seller}^* < E\pi_{v, seller}^*$; and the separating equilibrium is preferred to the pooling equilibrium.

Case 3: Let $\gamma_H v^k \geq T_{min} \geq \frac{p}{1+p} T_{min} > \gamma_L v^k$

(vi) Since the minimum transfer payment level which satisfies the liquidity constraint is greater than $\gamma_L v^k$, only a separating equilibrium can result. Like in case (v), in the separating equilibrium $T_{vi}^* = \gamma_H v^k$; $\beta_{vi}^* = 1$; and $E\pi_{vi, seller}^* = \phi\gamma_H v^k$.

Case 4: Let $T_{min} \geq \gamma_H v^k \geq \frac{p}{1+p} T_{min}$

(vii) In the separating equilibrium, $T_{vii}^* = \gamma_H v^k$; $\beta_{vii}^* = 1$; and $E\pi_{vii, seller}^* = \phi\gamma_H v^k - \phi p(T_{min} - \gamma_H v^k) = \phi\gamma_H v^k(1+p) - \phi p T_{min}$.

(viii) In the pooling equilibrium¹⁸, similar to case (iv), $T_{viii}^* = \gamma_L v^k$; $\beta_{viii}^* = 1$; and $E\pi_{viii, seller}^* = \gamma_L v^k - p(T_{min} - \gamma_L v^k)$.

Remark: The separating equilibrium in case (vii) is preferred to the pooling equilibrium in case (viii) because $E\pi_{vii, seller}^* - E\pi_{viii, seller}^* = p\phi\gamma_H v^k + p\gamma_L v^k + (1 - \phi)(T_{min} - \gamma_L v^k) > 0$. Note that MTP constraint binds only in subcase (vii) of case 4.

¹⁸The pooling equilibrium may result if $\gamma_L v^k \geq \frac{p}{1+p} T_{min}$.

Appendix Two

To compute the large buyers optimal MTP level T_{min} , we explore the optimal MTP level for the cases we explored in B1.

Pooling Equilibrium: $\gamma_L v^k \geq T_{min}$ with $(1 - \phi)\gamma_L v^k \geq T_{min}\phi(\frac{\gamma_H}{\gamma_L} - 1)$.

Under these conditions, the pooling equilibrium results, but the MTP is not triggered. The large buyer's expected additional revenue is $ER(pooling, buyer) = \alpha((\phi\gamma_H + (1 - \phi)\gamma_L)v^k - T_{min}\phi(\frac{\gamma_H}{\gamma_L} - 1))$. Since this expression is strictly decreasing in T_{min} , the optimal MTP level is zero, $T_{min}^* = 0$, and $ER(pooling, buyer) = \alpha(\phi\gamma_H + (1 - \phi)\gamma_L)v^k$.

Separating Equilibrium

In a separating equilibrium when the MTP is triggered, the large buyer can capture all of high-type small buyer's surplus by setting $T_{min} = \frac{\gamma_H v^k (1+p)}{p}$.¹⁹ Then, the large buyer's expected additional revenue is $ER(separating, buyer) = \phi\gamma_H v^k$. In the separating equilibrium when the MTP is not triggered, the large buyer's additional revenue is lower, $\alpha\phi\gamma_H v^k$.

¹⁹The seller is forced to set $T = \gamma_H v^k$ and $\beta = 1$ with $E\pi_{seller} = 0$.

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