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SUPPLEMENT TO "THE WELFARE EFFECTS OF VERTICAL INTEGRATION IN MULTICHANNEL TELEVISION MARKETS"

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S.A. NECESSARY EQUILIBRIUM CONDITIONS FOR AFFILIATE FEE BARGAINING

IN THIS SECTION, WE DESCRIBE AND ANALYZE an infinite-horizon extensive form bargaining game between channels and distributors that are not integrated with each other to motivate the necessary equilibrium conditions that we employ in our analysis. We do not model a non-cooperative bargaining game within integrated firms, and assume that internal affiliate fees are set in the Nash-in-Nash fashion described in the text. Implicitly, we take these internal affiliate fees as given here. We focus on bargaining between representatives for each channel and distributor; as noted in the main text, pricing and carriage decisions, possibly determined by other agents (e.g., local offices of each distributor), are taken as given by these bargaining agents.

Initially, assume that there are no agreements formed between any (non-integrated) channel and distributor. In each bargaining period, either distributors (in odd periods) or channels (in even periods) simultaneously make private offers to all counterparties with which they have not yet formed an agreement. An offer to form an agreement between a channel c and distributor f specifies a linear affiliate fee τ_{fc} in the set $T_{fc} = [\underline{\tau}_{fc}, \bar{\tau}_{fc}]$, where $\underline{\tau}_{fc} = -a_c$ and $\bar{\tau}_{fc} = \max\{\tau : \text{GFT}^M_{fc}(\tau, \{\underline{\tau}_{gc}\}_{g\neq f}) \geq 0\}$. In each bargaining period, those receiving offers simultaneously announce whether they will accept or reject the offer made to them. At the end of each bargaining period, the set of agreements is observed by all players. Payoffs in a bargaining period depend on the set of agreements in force following that period's bargaining. Once an agreement is reached between c and a distributor g, that agreement remains in force for the remainder of the game. Each channel has discount factor $\delta_c \equiv \exp(-r_c\Lambda)$ and each distributor has discount factor $\delta_d \equiv \exp(-r_d\Lambda)$ for $r_c, r_d, \Lambda > 0$, where Λ represents the length of time between periods.[1] We assume that, in any subgame, when receiving off-equilibrium path offers for that subgame, all agents have *passive beliefs*: that is, they continue to believe that other firms have received their

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[1]Our results can straightforwardly accommodate heterogeneous discount factors.

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equilibrium offers (or no offers at all, if that is what happens on the subgame's equilibrium path).

This setup matches the structure studied by Collard-Wexler, Gowrisankaran, and Lee (2018), with the exception that we assume firms bargain over linear fees as opposed to lump-sum transfers.

S.A.1. *Nash-in-Nash Conditions Are Necessary With Immediate Agreement*

We focus on equilibria in which all agreements are eventually formed among all channels and distributors.[2] We first show that, when players have passive beliefs in a pure-strategy perfect Bayesian equilibrium, any equilibrium in which all open agreements are immediately formed following any history of play yields the necessary conditions that we employ in estimating our model (under "No Integration" and "VI with PARs"). This result can provide a non-cooperative motivation for the Nash-in-Nash approach we adopt in the text for bargaining between non-integrated firms in non-loophole markets. Our approach extends results from Collard-Wexler, Gowrisankaran, and Lee (2018) (in particular, Theorem 4.1) to our setting with linear fees. However, we do not establish conditions under which equilibria must involve immediate agreement; this interesting question is beyond the scope of this paper.

Notation and Assumptions. Assume that Nash bargaining parameters for each (non-integrated) distributor f and channel c are given by $\zeta_{fc} = r_c/(r_c + r_d)$. We introduce the following notation:

• For any distributor-channel pair $fc \in \mathcal{A}$, where $\mathcal{A}$ represents the set of all non-integrated distributor-RSN pairs, we define the solution to their Nash bargaining problem given all other agreements $\mathcal{A} \setminus fc$ are formed at fees $\boldsymbol{\tau}_{\mathcal{A}\setminus fc} \equiv \{\tau_{gd}\}_{gd \in \mathcal{A}\setminus fc}$ as

$$\phi^N_{fc}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}) = \frac{(1-\zeta_{fc})\,\mathrm{GFT}^M_{fc}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot) - \zeta_{fc}\,\mathrm{GFT}^C_{fc}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot)}{D_f},$$

where $D_f = \sum_{m \in \mathcal{M}_{fc}} D_{fm}$ (and t subscripts have been removed for this section). Denote by $\tilde{\boldsymbol{\phi}}^N \equiv \{\tilde{\phi}^N_{fc}\}_{fc \in \mathcal{A}}$ the vector of Nash-in-Nash fees that solves the fixed point for all agreements; that is, $\tilde{\phi}^N_{fc} = \phi^N_{fc}(\tilde{\boldsymbol{\phi}}^N_{\mathcal{A}\setminus fc})$ $\forall fc \in \mathcal{A}$. Given our assumptions on firm profits, this vector is unique and can be solved for as the solution to $\tilde{\boldsymbol{\phi}}^N = (\boldsymbol{A}^N)^{-1}\boldsymbol{B}^N$, where each row of vectors $\tilde{\boldsymbol{\phi}}^N$ and $\boldsymbol{B}^N$ and square matrix $\boldsymbol{A}^N$ corresponds to a particular distributor f and channel c pair, and $\boldsymbol{A}^N$ and $\boldsymbol{B}^N$ are functions only of demand terms (which, given fixed downstream prices, are not influenced by affiliate fees), marginal costs, advertising, and bargaining parameters (see (S.13)). We also denote by $\tilde{\boldsymbol{\phi}}^N(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}})$ the *conditional* Nash-in-Nash vector of affiliate fees given agreements $\mathcal{B} \subset \mathcal{A}$ have been formed at fees $\boldsymbol{\tau}_{\mathcal{B}} \equiv \{\tau_{gd}\}_{gd \in \mathcal{B}}$. Each element $fc \in \mathcal{A} \setminus \mathcal{B}$ of this conditional Nash-in-Nash vector will satisfy $\tilde{\phi}^N_{fc}(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}}) = \phi^N_{fc}(\{\tilde{\boldsymbol{\phi}}^N_{\mathcal{A}\setminus(\mathcal{B}\cup fc)}(\cdot), \boldsymbol{\tau}_{\mathcal{B}}\})$, and such a vector will also be unique for each $(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}})$.

[2]For 97% of cable system-RSN combinations (where the RSN is relevant for the system and is one of the 26 RSNs that we analyze), the owner of the system carries the RSN on at least one system (and thus has an agreement with the RSN). Satellite distributors are supplied with all non-loophole RSNs in our sample.

• Recall that (downstream) distributors make offers in odd periods; (upstream) channels make offers in even periods. For any $fc \in \mathcal{A}$, let $\{\phi^R_{fc,D}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}), \phi^R_{fc,U}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc})\}$ represent the downstream and upstream "Rubinstein fees" that correspond to the odd- and even-period offers that are made in equilibrium in a Rubinstein (1982) alternating offers game between just f and c, given all other agreements in $\mathcal{A} \setminus fc$ have been (or are expected to be immediately) formed at affiliate fees $\boldsymbol{\tau}_{\mathcal{A}\setminus fc}$. Such Rubinstein fees are

$$\phi^R_{fc,D}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}; \Lambda) = \frac{\delta_c(1-\delta_d)\,\mathrm{GFT}^M_{fct}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot) - (1-\delta_c)\,\mathrm{GFT}^C_{fc}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot)}{(1-\delta_c\delta_d)D_f},$$

$$\phi^R_{fc,U}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}; \Lambda) = \frac{(1-\delta_d)\,\mathrm{GFT}^M_{fct}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot) - \delta_d(1-\delta_c)\,\mathrm{GFT}^C_{fc}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot)}{(1-\delta_c\delta_d)D_f}.$$

For notational simplicity, we will often suppress the dependence on Λ.

As with Nash-in-Nash fees, we define $\tilde{\boldsymbol{\phi}}^R_D \equiv \{\tilde{\phi}^R_{fc,D}\}_{fc\in\mathcal{A}}$ and $\tilde{\boldsymbol{\phi}}^R_U \equiv \{\tilde{\phi}^R_{fc,U}\}_{fc\in\mathcal{A}}$ to be the vector of Rubinstein fees that solves the fixed point of the equations above; similarly, these vectors of fees are unique for given discount factors (given pricing and carriage decisions), and can be solved for explicitly as $\tilde{\boldsymbol{\phi}}^R_D = (\boldsymbol{A}^R_D(\Lambda))^{-1}\boldsymbol{B}^R_D(\Lambda)$ and $\tilde{\boldsymbol{\phi}}^R_U = (\boldsymbol{A}^R_U(\Lambda))^{-1}\boldsymbol{B}^R_U(\Lambda)$, where matrices $\{\boldsymbol{A}^R_l(\cdot), \boldsymbol{B}^R_l(\cdot)\}_{l\in\{D,U\}}$ condition on Λ in addition to the terms used in $\boldsymbol{A}^N$ and $\boldsymbol{B}^N$. As before, let $\tilde{\boldsymbol{\phi}}^R_D(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}})$ and $\tilde{\boldsymbol{\phi}}^R_U(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}})$ represent the vector of conditional Rubinstein fees for agreements in $\mathcal{A} \setminus \mathcal{B}$ that solve the fixed point of the Rubinstein fee equations above given other agreements in $\mathcal{B}$ have been formed at fees $\boldsymbol{\tau}_{\mathcal{B}}$.

Three properties of these fees are crucial for our results. First, if a downstream (upstream) firm receives a Rubinstein offer in an even (odd) period and expects that all other agreements will form, that firm is indifferent between accepting and rejecting the offer:

$$(1-\delta_d)\,\mathrm{GFT}^M_{fc}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot) = \left[\phi^R_{fc,U}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}) - \delta_d\phi^R_{fc,D}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc})\right] \times [D_f], \tag{S.1}$$

$$(1-\delta_c)\,\mathrm{GFT}^C_{fc}(0, \boldsymbol{\tau}_{\mathcal{A}\setminus fc}, \cdot) = \left[\delta_c\phi^R_{fc,U}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}) - \phi^R_{fc,D}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc})\right] \times [D_f]. \tag{S.2}$$

For example, the first equation states that for a downstream distributor f, the one-period change in its gains-from-trade (left-hand side) by rejecting an offer from c (given all other agreements form at fees $\boldsymbol{\tau}_{\mathcal{A}\setminus fc}$) is equal to the difference between anticipated payments it would make if it agreed to upstream Rubinstein fees this period, or downstream Rubinstein fees in the following period (right-hand side). Second, for any $fc \in \mathcal{A}$ and $\boldsymbol{\tau}_{\mathcal{A}\setminus fc}$, $\phi^R_{fc,D}(\cdot) < \phi^N_{fc}(\cdot) < \phi^R_{fc,U}(\cdot)$; and $\lim_{\Lambda\to 0}\phi^R_{fc,D}(\cdot) = \lim_{\Lambda\to 0}\phi^R_{fc,U}(\cdot) = \phi^N_{fc}(\cdot)$. Third, (conditional) Rubinstein fees also converge to (conditional) Nash-in-Nash fees: $\lim_{\Lambda\to 0}\tilde{\boldsymbol{\phi}}^R_D = \lim_{\Lambda\to 0}\tilde{\boldsymbol{\phi}}^R_U = \tilde{\boldsymbol{\phi}}^N$; and $\lim_{\Lambda\to 0}\tilde{\boldsymbol{\phi}}^R_D(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}}) = \lim_{\Lambda\to 0}\tilde{\boldsymbol{\phi}}^R_U(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}}) = \tilde{\boldsymbol{\phi}}^N(\mathcal{B}, \boldsymbol{\tau}_{\mathcal{B}})$ for any set of agreements $\mathcal{B}$ and affiliate fees $\boldsymbol{\tau}_{\mathcal{B}}$.[3]

S.A.1.1. *Results*

We first state and prove the following lemma.

[3]Note that $\lim_{\Lambda\to 0}\boldsymbol{A}^R_D(\Lambda) = \lim_{\Lambda\to 0}\boldsymbol{A}^R_U(\Lambda) = \boldsymbol{A}^{\mathrm{Nash}}$ (which is invertible), and $\lim_{\Lambda\to 0}\boldsymbol{B}^R_D(\Lambda) = \lim_{\Lambda\to 0}\boldsymbol{B}^R_U(\Lambda) = \boldsymbol{B}^{\mathrm{Nash}}$ (and similarly for the matrices used to compute conditional Rubinstein and Nash fees).

LEMMA 1: *Consider any set of affiliate fees* $\boldsymbol{\tau}^*_{\mathcal{A}} \equiv \{\tau^*_{fc}\}_{fc\in\mathcal{A}}$ *and set of agreements* $\mathcal{A}_1 \subset \mathcal{A}$ *such that* $\mathcal{A}_2 \equiv \mathcal{A} \setminus \mathcal{A}_1$ *only contains agreements involving a single channel* c. *Suppose that* (i) $\sum_{m\in\mathcal{M}_{fc}:c\in\mathcal{B}_{gm}}[\Delta_{fc}D_{gm}]/D_f < 1/(\bar{n}_c - 1)$ *for all distributors* f *and* g *that are present in any of channel c's relevant markets*, *where* $\bar{n}_c$ *is the total number of distributors in c's relevant markets*; *and* (ii) $\tau^*_{fc} \geq \phi^R_{fc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})\ \forall fc \in \mathcal{A}_2$. *Then* $\phi^N_{fc}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc}) > \phi^N_{fc}(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \{\tilde{\phi}^R_{gc,D}(\mathcal{A}_1, \boldsymbol{\tau}^*_{\mathcal{A}_1})\}_{gc\in\mathcal{A}_2\setminus fc}\})\ \forall fc \in \mathcal{A}_2$.

REMARK: Condition (i) in the lemma states that any distributor f that has an agreement with a channel c loses no more than $1/(\bar{n}_c - 1)$ share of its subscribers in c's relevant markets to some rival distributor $g \neq f$ upon disagreement with channel c; we confirm that this condition is satisfied for all distributor-RSN pairs in our analysis.[4] Condition (ii) in the lemma states that downstream Rubinstein fees are lower than τ^*_{fc} for $fc \in \mathcal{A}_2$. Intuitively, the lemma follows because the Nash bargaining outcome for pair fc involves a lower affiliate fee if c's affiliate fees with other distributors are lower (raising c's gains from trade with f).

PROOF OF LEMMA 1: Let $n = |\mathcal{A}_2|$ denote the dimension of $\mathcal{A}_2$—that is, the number of agreements c has open in $\mathcal{A}_2$; and let $D \subset \mathbb{R}^n$ denote the compact set of potential affiliate fees for agreements in $\mathcal{A}_2$. We first prove that the mapping $\Gamma : D \to D$, where $\Gamma(\boldsymbol{\tau}_{\mathcal{A}_2}) = [\phi^R_{fc,D}(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \boldsymbol{\tau}_{\mathcal{A}_2\setminus fc}\})]_{fc\in\mathcal{A}_2}$ is a contraction. For any $\boldsymbol{\tau}_{\mathcal{A}_2}, \boldsymbol{\tau}'_{\mathcal{A}_2} \in D$, let $\boldsymbol{d} \equiv \boldsymbol{\tau}_{\mathcal{A}_2} - \boldsymbol{\tau}'_{\mathcal{A}_2}$, and $\boldsymbol{\varepsilon} \equiv \Gamma(\boldsymbol{\tau}_{\mathcal{A}_2}) - \Gamma(\boldsymbol{\tau}'_{\mathcal{A}_2})$. By (S.12) and the definition of $\phi^R_{fc,D}(\cdot)$, we can write

$$\varepsilon_{fc} = -\frac{(1-\delta_c)}{(1-\delta_c\delta_d)} \times \sum_{g\neq f, m\in\mathcal{M}_{fc}:c\in\mathcal{B}_{gm}} \frac{[\Delta_{fc}D_{gm}]}{D_f} d_{gc}.$$

Since $n \leq \bar{n}_c$, condition (i) implies that $\sum_{m\in\mathcal{M}_{fc}:c\in\mathcal{B}_{gm}}[\Delta_{fc}D_{gm}]/D_f < 1/(n-1)$ for all f and $g \neq f$ that have an agreement with c, and we have

$$\sum_{gc\in\mathcal{A}_2} |\varepsilon_{gc}| \leq \underbrace{\frac{1-\delta_c}{1-\delta_c\delta_d} \times \frac{n-1}{n-1}}_{q} \times \sum_{gc\in\mathcal{A}_2} |d_{gc}|;$$

hence $\|\boldsymbol{\varepsilon}\|_1 \leq q \times \|\boldsymbol{d}\|_1$, where $0 \leq q < 1$. Thus, $\Gamma(\cdot)$ is a contraction with a unique fixed point $\tilde{\boldsymbol{\phi}}^R_D(\mathcal{A}_1, \boldsymbol{\tau}^*_{\mathcal{A}_1})$.

Next, note that both $\phi^R_{fc,D}(\cdot)$ and $\phi^N_{fc}(\cdot)$ are increasing in all fees $\{\tau_{gc}\}_{g\neq f}$: as c obtains greater demand from another distributor $g \neq f$ when it disagrees with f, $\mathrm{GFT}^C_{fc}(\cdot)$ is decreasing in τ_{gc} and $\mathrm{GFT}^M_{fc}(\cdot)$ is unaffected by τ_{gc}. Since $\tau^*_{fc} \geq \phi^R_{fc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})\ \forall fc \in \mathcal{A}_2$ by condition (ii), it follows that $\forall fc \in \mathcal{A}_2$:

$$\begin{aligned}
\phi^R_{fc,D}\big(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \boldsymbol{\tau}^*_{\mathcal{A}_2\setminus fc}\}\big) &\geq \phi^R_{fc,D}\big(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \{\phi^R_{gc,D}(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \boldsymbol{\tau}^*_{\mathcal{A}_2\setminus gc}\})\}_{gc\in\mathcal{A}_2\setminus fc}\}\big) \\
&\geq \phi^R_{fc,D}\big(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \{\Gamma^\infty_{gc}(\boldsymbol{\tau}^*_{\mathcal{A}_2})\}_{gc\in\mathcal{A}_2\setminus fc}\}\big) \qquad \text{(S.3)} \\
&= \tilde{\phi}^R_{fc,D}\big(\mathcal{A}_1, \boldsymbol{\tau}^*_{\mathcal{A}_1}\big),
\end{aligned}$$

[4]The maximum number of distributors in any RSN's relevant markets is 7, and the largest predicted share of subscribers lost by a distributor to a rival distributor in an RSN's relevant markets upon disagreement with that RSN is 0.14 (at estimated parameter values); this occurs when Dish does not carry NESN and loses subscribers to Comcast.

where $\Gamma^{\infty}(\cdot)$ represents the fixed point of the contraction mapping $\Gamma(\cdot)$. In turn, this implies that

$$\phi^N_{fc}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc}) \geq \phi^N_{fc}(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \{\phi^R_{gc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})\}_{gc\in\mathcal{A}_2\setminus fc}\}) \geq \phi^N_{fc}(\{\boldsymbol{\tau}^*_{\mathcal{A}_1}, \{\tilde{\phi}^R_{gc,D}(\mathcal{A}_1, \boldsymbol{\tau}^*_{\mathcal{A}_1})\}_{gc\in\mathcal{A}_2\setminus fc}\}),$$

where the last inequality follows from (S.3). *Q.E.D.*

We now state and prove our main result for this subsection:

PROPOSITION 2: *For any $\varepsilon > 0$, there exists $\bar{\Lambda} > 0$ such that for all strictly positive $\Lambda < \bar{\Lambda}$, in any no-delay equilibrium (in which all open agreements in $\mathcal{A}$ immediately form after any history of play) where agreements immediately form at affiliate fees $\boldsymbol{\tau}^{*,1}_{\mathcal{A}}$, $|\tilde{\phi}^N_{fc} - \tau^{*,1}_{fc}| < \varepsilon$ $\forall fc \in \mathcal{A}$.*

PROOF: We establish this result in two steps.

Step 1: One Channel With Open Agreements in Period 2. Consider a subgame beginning in period 2 in which $\mathcal{A}_1 \subset \mathcal{A}$ agreements have already been formed at affiliate fees $\boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}$, and all open agreements $\mathcal{A}_2 \equiv \mathcal{A} \setminus \mathcal{A}_1$ involve only a single channel c (who makes offers in this period). In any no-delay equilibrium, all agreements in $\mathcal{A}_2$ immediately form at some set of fees $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2}$. We prove that as $\Lambda \to 0$, these fees $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2}$ must be arbitrarily close to the conditional Nash-in-Nash fees $\tilde{\boldsymbol{\phi}}^N(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1})$.

1. First, consider a deviation by some distributor f to reject an offer from c and form an agreement with c in the following period at fees $\phi^R_{fc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})$, where $\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc} \equiv \{\boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}, \boldsymbol{\tau}^{*,2}_{\mathcal{A}_2\setminus fc}\}$; this is the unique subgame outcome with one open agreement (Rubinstein (1982)). For such a deviation not to be profitable, it must be that $\forall fc \in \mathcal{A}_2$:

$$\underbrace{(\tau^{*,2}_{fc} - \delta_d \phi^R_{fc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc}))D_f}_{\text{Savings in affiliate fee payments}} \leq \underbrace{(1-\delta_d)\,\mathrm{GFT}^M_{fc}(0, \boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})}_{\text{One period gross profit change}}$$

$$(\Leftrightarrow) \quad \tau^{*,2}_{fc} \leq \phi^R_{fc,U}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc}),$$

where the substitution follows from (S.1).

2. Next, consider a deviation by channel c to not form some agreement $fc \in \mathcal{A}_2$ in period 2 (by demanding from f a sufficiently high fee or simply not making f an offer), but still form all other agreements $\mathcal{A}_2 \setminus fc$ at fees $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2\setminus fc}$. Following this deviation, channel c expects agreement fc to form in the following period at fee $\phi^R_{fc,D}(\tau^*_{\mathcal{A}\setminus fc})$. Thus, for channel c to not find such a deviation profitable, it must be that

$$\underbrace{(1-\delta_c)\,\mathrm{GFT}^C_{fc}(0, \boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})}_{\text{One-period gross profit change}} \geq \underbrace{(\delta_c \phi^R_{fc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc}) - \tau^{*,2}_{fc}) \times D_f}_{\text{Gains in affiliate fee payments}}$$

$$(\Leftrightarrow) \quad \tau^{*,2}_{fc} \geq \delta_c \phi^R_{fc,D}(\boldsymbol{\tau}^*_{\mathcal{A}\setminus fc}) - \frac{(1-\delta_c)\,\mathrm{GFT}^C_{fc}(0, \boldsymbol{\tau}^*_{\mathcal{A}\setminus fc})}{D_f}.$$

3. Consider any strictly positive sequence $\{\Lambda_k\} \to 0$, and period 2 no-delay equilibrium fees $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2,k}$ associated with Λ_k. Define functions

$$f(\boldsymbol{\tau}_{\mathcal{A}_2}) = [\phi^N_{fc}(\{\boldsymbol{\tau}_{\mathcal{A}_2\setminus fc}, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}\})]_{fc\in\mathcal{A}_2},$$

$$g_k(\boldsymbol{\tau}_{\mathcal{A}_2}) = \Bigg[\delta_c(\Lambda_k)\phi^R_{fc,D}\big(\{\boldsymbol{\tau}_{\mathcal{A}_2\setminus fc}, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}\}; \Lambda_k\big) - \frac{\big(1-\delta_c(\Lambda_k)\big)\,\mathrm{GFT}^C_{fc}\big(0, \{\boldsymbol{\tau}_{\mathcal{A}_2\setminus fc}, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}\}\big)}{D_f}\Bigg]_{fc\in\mathcal{A}_2},$$

and

$$h_k(\boldsymbol{\tau}_{\mathcal{A}_2}) = \big[\phi^R_{fc,U}\big(\{\boldsymbol{\tau}_{\mathcal{A}_2\setminus fc}, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}\}; \Lambda_k\big)\big]_{fc\in\mathcal{A}_2}.$$

Note that $g_k(\cdot)$ and $h_k(\cdot)$ are continuous and converge uniformly to $f(\cdot)$ as $k \to \infty$, and $f(\cdot)$ has a unique fixed point $\tilde{\boldsymbol{\phi}}^N(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1})$. We have shown that $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2,k} \in [g_k(\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2,k}), h_k(\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2,k})]$ (for $k \geq 2$). Thus, as affiliate fees are restricted to a compact set, it follows that $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2,k}$ must converge to the fixed point of $f(\cdot)$—that is, to $\tilde{\boldsymbol{\phi}}^N(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1})$ as $k \to \infty$.

Step 2: All Agreements Open in Period 1. Now consider a no-delay equilibrium where all agreements in $\mathcal{A}$ immediately form in period 1 at fees $\boldsymbol{\tau}^{*,1}_{\mathcal{A}}$. We now prove that our proposition holds for offers formed in period 1 (when distributors make offers).

1. First, consider a deviation by some channel c to reject an offer from a distributor f and form an agreement with f in the following period at fees $\phi^R_{fc,U}(\boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc})$ (by the arguments above). For such a deviation to not be profitable, it must be that $\forall fc \in \mathcal{A}$:

$$\underbrace{(1-\delta_d)\,\mathrm{GFT}^C_{fc}(0,\cdot)}_{\text{One period gross profit change}} \geq \underbrace{\big(\delta_d\phi^R_{fc,U}(\cdot) - \tau^{*,1}_{fc}\big)D_f}_{\text{Gain in affiliate fee payments}}$$

$$(\Leftrightarrow) \quad \tau^{*,1}_{fc} \geq \phi^R_{fc,D}\big(\boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc}\big),$$

where the substitution follows from (S.2).

2. Next, we show that for any strictly positive sequence $\{\Lambda_k\} \to 0$, there exists a corresponding strictly positive sequence $\{\varepsilon_k\} \to 0$ such that for any vector of equilibrium affiliate fees $\boldsymbol{\tau}^{*,1}_{\mathcal{A},k}$ given Λ_k, it must be that $\tau^{*,1}_{fc,k} \leq \phi^N_{fc}(\boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc,k}) + \varepsilon_k$ $\forall fc \in \mathcal{A}$. We proceed by contradiction: assume not, so that there exists a strictly positive infinite sequence $\{\Lambda_k\} \to 0$ and $\underline{\varepsilon} > 0$ such that for all k there is an equilibrium vector of affiliate fees $\boldsymbol{\tau}^{*,1}_{\mathcal{A},k}$ given Λ_k where $\tau^{*,1}_{fc,k} > \phi^N_{fc}(\boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc,k}) + \underline{\varepsilon}$ for some $fc \in \mathcal{A}$. Consider a deviation by distributor f to make channel c an unacceptable offer (or no offer at all). Channel c may, upon receiving the unacceptable offer, reject some set of offers $\mathcal{A}_2$ (that include fc and offers made to it by distributors other than f); all other agreements $\mathcal{A}_1 = \mathcal{A} \setminus \mathcal{A}_2$ form in period 1, while these agreements form in the next bargaining period. For any $fc \in \mathcal{A}$, observe that there exists a $\bar{\Lambda}_{fc} > 0$ such that, for all $\Lambda_k < \bar{\Lambda}_{fc}$, for any set of agreements $\mathcal{A}_2 \subseteq \mathcal{A}$ that only involve channel c and include fc, the following three conditions hold:

i. if c rejects agreements $\mathcal{A}_2$ in period 1 and they form in period 2 at equilibrium fees $\boldsymbol{\tau}^{*,2}_{\mathcal{A}_2}$, then $|\delta_d\tau^{*,2}_{fc} - \tilde{\phi}^N_{fc}(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1,k})| < \underline{\varepsilon}/3$ (as we have proven that in any equilibrium, if $\mathcal{A}_2$ only contains agreements involving a single channel, they must form at fees which converge to $\tilde{\boldsymbol{\phi}}^N(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1,k})$);

ii. the absolute value of the one-period gross profit change for f from $\mathcal{A}_2$ forming is less than $\underline{\varepsilon}/3 \times D_f$ (as profits for f are bounded for any set of finite affiliate fees);

iii. $|\phi^N_{fc}(\{\boldsymbol{\tau}^{*,1}_{\mathcal{A}_1,k}, \{\tilde{\phi}^R_{gc,D}(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1,k})\}_{gc\in\mathcal{A}_2\setminus fc}\}) - \tilde{\phi}^N_{fc}(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1,k})| < \underline{\varepsilon}/3$ (as conditional Rubinstein fees converge to conditional Nash-in-Nash fees).

Choose any k in the sequence such that $\Lambda_k < \min_{fc\in\mathcal{A}}\{\bar{\Lambda}_{fc}\}$. By our contradictory assumption, at such Λ_k, there is a vector of equilibrium affiliate fees $\boldsymbol{\tau}^*_{\mathcal{A}_1}$ such that $\tau^{*,1}_{fc,k} > \phi^N_{fc}(\boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc,k}) + \underline{\varepsilon}$ for some $fc \in \mathcal{A}$. Given these fees, distributor f's gain from making c an unacceptable offer in period 1 (regardless of the set of offers $\mathcal{A}_2$ that c rejects) is (where we suppress the subscript k):

$$\underbrace{\left(\tau^{*,1}_{fc} - \delta_d \tau^{*,2}_{fc}\right) \times D_f}_{\text{Savings in affiliate fee payments}} - \underbrace{\left(\text{GFT}^M_{f,\mathcal{A}_2}\left(0, \boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc}\right) - \delta_d \,\text{GFT}^M_{f,\mathcal{A}_2}\left(0, \left\{\boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}, \boldsymbol{\tau}^{*,2}_{\mathcal{A}_2\setminus fc}\right\}\right)\right)}_{\text{One-period gross profit change}}$$

$$> \underbrace{\left(\underline{\varepsilon} + \phi^N_{fc}\left(\left\{\boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}, \left\{\tilde{\phi}^R_{gc,D}\left(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}\right)\right\}_{gc\in\mathcal{A}_2\setminus fc}\right\}\right)\right.}_{<\,\tau^{*,1}_{fc} \text{ by contradictory assumption and Lemma 1}} - \underbrace{\left.\left(\tilde{\phi}^N_{fc}\left(\mathcal{A}_1, \boldsymbol{\tau}^{*,1}_{\mathcal{A}_1}\right) + \underline{\varepsilon}/3\right)\right)}_{>\,\delta_d \tau^{*,2}_{fc} \text{ by condition (i)}} \times D_f - (\underline{\varepsilon}/3) D_f$$

$$> (\underline{\varepsilon} - \underline{\varepsilon}/3 - \underline{\varepsilon}/3 - \underline{\varepsilon}/3) \times D_f = 0,$$

where the second line follows from our contradictory assumption, Lemma 1, and conditions (i) and (ii) (where $\text{GFT}^M_{f,\mathcal{A}_2}(\cdot)$, representing distributor f's one-period gross profit change from agreements in $\mathcal{A}_2$ forming, does not depend on $\{\tau_{gc}\}_{g\neq f}$); and the last line follows from condition (iii). There is therefore a profitable deviation; contradiction.

3. Consider any strictly positive sequence $\{\Lambda_k\} \to 0$, and period 1 no-delay equilibrium fees $\boldsymbol{\tau}^{*,1}_{\mathcal{A},k}$ associated with Λ_k. By the previous step, there exists a corresponding strictly positive sequence $\{\varepsilon_k\} \to 0$ such that equilibrium fees $\tau^{*,1}_{fc,k} \leq \phi^N_{fc}(\boldsymbol{\tau}^{*,1}_{\mathcal{A}\setminus fc,k}) + \varepsilon_k$ for all $fc \in \mathcal{A}$. Define functions $f(\boldsymbol{\tau}_{\mathcal{A}}) = [\phi^N_{fc}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc})]_{fc\in\mathcal{A}}$, $g_k(\boldsymbol{\tau}_{\mathcal{A}}) = [\phi^R_{fc,D}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}; \Lambda_k)]_{fc\in\mathcal{A}}$, and $h_k(\boldsymbol{\tau}_{\mathcal{A}}) = [\phi^N_{fc}(\boldsymbol{\tau}_{\mathcal{A}\setminus fc}) + \varepsilon_k]_{fc\in\mathcal{A}}$. Note that $g_k(\cdot)$ and $h_k(\cdot)$ are continuous, converge uniformly to $f(\cdot)$ as $k \to \infty$, and $f(\cdot)$ has a unique fixed point $\tilde{\boldsymbol{\phi}}^N$. We have shown that $\boldsymbol{\tau}^{*,1}_{\mathcal{A},k} \in [g_k(\boldsymbol{\tau}^{*,1}_{\mathcal{A},k}), h_k(\boldsymbol{\tau}^{*,1}_{\mathcal{A}_1,k})]$. Thus, as affiliate fees are restricted to a compact set, it follows that $\boldsymbol{\tau}^{*,1}_{\mathcal{A},k}$ converges to the fixed point of $f(\cdot)$—that is, to $\tilde{\boldsymbol{\phi}}^N$ as $k \to \infty$. *Q.E.D.*

S.A.2. *Negative Three-Party-Surplus as a Necessary Condition for Non-Supply*

For the rest of this section, we consider a single channel negotiating with a single cable distributor f and two satellite providers (labeled here as g and g') in an environment where there are no program access rules in effect. Consider the situation in which neither satellite distributor is supplied with channel c and we have equilibrium bundles $\mathcal{B}^o$, bundle prices $\boldsymbol{p}^o$, affiliate fees $\boldsymbol{\tau}^o$, and implied bundle marginal costs $\boldsymbol{mc}^o$.[5] We focus on stationary perfect Bayesian equilibria, in which continuation play depends only on the set of agreements already reached.

We now show that if three-party-surplus, given by the left-hand side of (22), is positive, then there cannot be a perfect Bayesian equilibrium with passive beliefs in the bargaining game described above in which, starting in any subgame with no deals yet reached (including at the start of the game), it is certain that no deals will be reached in the continuation game. To do so, we show that if that was the case, then at channel c's first opportunity to make an offer, it could deviate and simultaneously make affiliate fee offers $\tilde{\tau}_{gc}$ to distributor g and $\tilde{\tau}_{g'c}$ to distributor g' having the properties that:

[5]For expositional convenience, we suppress the bargaining with the integrated distributor. The channel's deviation described below could be done once the channel has reached its internal agreement.

(i) both satellite distributors anticipate greater expected profit by accepting their offer than if no agreements are reached, regardless of each satellite distributor's beliefs regarding whether the other satellite distributor will be supplied;

(ii) channel c's profits are greater if both offers are accepted than if no agreements are reached.

By hypothesis, if channel c makes these offers, then—given passive beliefs—each distributor, say distributor g, believes that the rival distributor g' will not reach an agreement in this bargaining period. Thus, distributor g believes that no deals will be reached in this period if it rejects the offer made to it, and hence no deals will occur in the continuation play either. On the other hand, if g accepts, then while only g will accept this period, once it has accepted, channel c and the rival distributor g' may reach a deal in the future. If p_t denotes the probability that a deal is reached between channel c and the rival distributor g' exactly t periods after the deal with g (where $p_0 \equiv 0$), then g's expected payoff from acceptance is a weighted average of its payoffs when only it accepts offer $\tilde{\tau}_{gc}$ and when distributor g' is also immediately supplied (recall that g's payoff depends only on whether g' reaches an agreement with channel c, not on the level of the affiliate fee c and g' agree to), where the weight on the latter payoff is $\phi_g \equiv \sum_{t=0} \delta_d^t p_t$. Thus, property (i) implies that distributor g will prefer to accept channel c's offer regardless of its belief about ϕ_g. Since this is true for both distributors, property (ii) implies that the deviation is profitable for channel c.

In the remainder of this appendix, we show that if three-party-surplus, given by the left-hand side of (22), is positive and a certain positive margin condition holds (which we verify in our empirical work), then there is a pair of affiliate fees $(\tilde{\tau}_{gc}, \tilde{\tau}_{g'c})$ at which properties (i) and (ii) hold. This motivates our use of negative three-party-surplus as a *necessary* condition for non-supply of both satellite distributors g and g' to be an equilibrium, as otherwise c would find it profitable to make such offers.

Notation. Define

$$D_g(\mathcal{A}) \equiv \sum_m D_{gm}(\mathcal{B}_m^o \cup \mathcal{A}, \boldsymbol{p}_m^o, \cdot),$$

$$\pi_g(\mathcal{A}) \equiv \sum_m D_{gm}(\mathcal{B}_m^o \cup \mathcal{A}, \boldsymbol{p}_m^o, \cdot) \times \underbrace{\left(p_{gm}^{o,\text{pre-tax}} - mc_{gm}^o\right)}_{marg_{gm}^o}$$

to be distributor g's demand and profits when the distributor-channel pairs contained in $\mathcal{A}$ are added to all bundles; for example, $D_g(gc, \emptyset) = \sum_m D_{gm}(\mathcal{B}_m^o \cup \{gc\}, \cdot)$ and $D_g(gc, g'c) = \sum_m D_{gm}(\mathcal{B}_m^o \cup \{gc, g'c\}, \cdot)$. Define

$$[\Delta_{\mathcal{B}} D_g(\mathcal{A})] \equiv \sum_m \underbrace{D_{gm}(\mathcal{B}_m^o \cup \mathcal{A}, \cdot) - D_{gm}(\mathcal{B}_m^o \cup \{\mathcal{A} \setminus \mathcal{B}\}, \cdot)}_{\Delta_{\mathcal{B}} D_{gm}(\mathcal{A})},$$

$$[\Delta_{\mathcal{B}} \pi_g(\mathcal{A})] \equiv \sum_m \left(D_{gm}(\mathcal{B}_m^o \cup \mathcal{A}, \cdot) - D_{gm}(\mathcal{B}_m^o \cup \{\mathcal{A} \setminus \mathcal{B}\}, \cdot)\right) \times \left(p_{gm}^{o,\text{pre-tax}} - mc_{gm}^o\right)$$

for $\mathcal{B} \subseteq \mathcal{A}$ to be distributor g's change in demand and profits when the distributor-channel pairs contained in $\mathcal{B}$ are removed from $\mathcal{A}$: for example, $\Delta_{gc}\pi_g(gc, g'c)$ represents the difference in distributor g's profits from when both g and g' carry channel c versus when only g' carries c (not including any affiliate fees paid to channel c). In terms of notation used in the main text,

$$\pi_g(gc, g'c) = \sum_m \Pi^M_{gm}(\mathcal{B}^o_m \cup \{gc, g'c\}, p^o_m, \boldsymbol{\tau}'),$$

$$\Delta_{gc,g'c}\pi_g(gc, g'c) = \sum_m \Delta_{gc,g'c}\Pi^M_{gm}(\mathcal{B}^o_m \cup \{gc, g'c\}, p^o_m, \boldsymbol{\tau}'),$$

where $\boldsymbol{\tau}' \equiv \{\boldsymbol{\tau}^o \cup (\tau_{gc} = 0, \tau_{g'c} = 0)\}$.

Acceptable Offers. Satellite distributor g will accept an affiliate fee offer $\tilde{\tau}_{gc}$ from channel c and carry the channel if its expected increase in profits from doing so exceeds the expected payments, that is, if the following inequality holds:

$$\begin{aligned}&\left(\phi_g \times \left[\Delta_{gc,g'c}\pi_g(gc, g'c)\right] + (1-\phi_g) \times \left[\Delta_{gc}\pi_g(gc, \emptyset)\right]\right)\\ &\quad > \tilde{\tau}_{gc}\left(\phi_g \times D_g(gc, g'c) + (1-\phi_g) \times D_g(gc, \emptyset)\right),\end{aligned}$$

where $\phi_g \in [0, 1]$ represents distributor g's discounted probability that after accepting deviant offer $\tilde{\tau}_{gc}$ from channel c, the other distributor g' is also supplied. This condition is equivalent to

$$\tilde{\tau}_{gc} < \frac{\left(\phi_g \times \left[\Delta_{gc,g'c}\pi_g(gc, g'c)\right] + (1-\phi_g) \times \left[\Delta_{gc}\pi_g(gc, \emptyset)\right]\right)}{\left(\phi_g \times D_g(gc, g'c) + (1-\phi_g) \times D_g(gc, \emptyset)\right)}. \tag{S.4}$$

Define

$$A_g \equiv \frac{\left[\Delta_{gc,g'c}\pi_g(gc, g'c)\right]}{D_g(gc, g'c)}, \qquad B_g \equiv \frac{\left[\Delta_{gc}\pi_g(gc, \emptyset)\right]}{D_g(gc, \emptyset)}.$$

Note that the numerators of both A_g and B_g are positive: that is, the change in g's profits from carrying channel c equals the increase in g's demand due to carrying channel c multiplied by strictly positive margins in every market (which is the case in the data for both satellite distributors at estimated marginal costs). The derivative of the right-hand side of (S.4) with respect to ϕ_g is weakly positive if $A_g \geq B_g$, and strictly negative otherwise. Thus, if

$$\tilde{\tau}_{gc}(\varepsilon) = \min\Bigg(\underbrace{\frac{\left[\Delta_{gc,g'c}\pi_g(gc, g'c)\right]}{D_g(gc, g'c)}}_{A_g}, \underbrace{\frac{\left[\Delta_{gc}\pi_g(gc, \emptyset)\right]}{D_g(gc, \emptyset)}}_{B_g}\Bigg) - \varepsilon \tag{S.5}$$

for $\varepsilon > 0$, then (S.4) is satisfied for any $\phi_g \in [0, 1]$, and g will accept $\tilde{\tau}_{gc}(\varepsilon)$. Define $\tilde{\tau}_{g'c}(\varepsilon)$ similarly.

Profitable for Channel c to Make Offers. Consider now the decision by channel c to offer both satellite distributors the set of affiliate fees $\{\tilde{\tau}_{gc}(\varepsilon), \tilde{\tau}_{g'c}(\varepsilon)\}$ as defined in (S.5), where $\varepsilon > 0$. Assume that the following *positive margin condition* holds:

$$\left(p^{o,\text{pre-tax}}_{gm} - mc^o_{gm} - \tilde{\tau}_{gc}(0)\right) > 0 \quad \text{for all } m,$$

a condition that we have verified holds for each satellite distributor in every market for every RSN when program access rules are not enforced.

We now establish that if three-party-surplus is positive, then c wishes to make such offers; that is,[6]

$$\begin{aligned}\sum_m &\big[\big[\Delta_{gc,g'c}\Pi^M_{gm}\big(\{\mathcal{B}^o_m \cup \{gc, g'c\}\}, \cdot\big)\big] \\ &+ \big[\Delta_{gc,g'c}\Pi^M_{g'm}\big(\{\mathcal{B}^o_m \cup \{gc, g'c\}\}, \cdot\big)\big] \\ &+ \big[\Delta_{gc,g'c}\Pi^C_{cm}\big(\{\mathcal{B}^o_m \cup \{gc, g'c\}\}, \cdot\big)\big]\big] \\ &\equiv E > 0\end{aligned} \tag{S.6}$$

implies that, for sufficiently small $\varepsilon > 0$,

$$\underbrace{\sum_m \big[\Delta_{gc,g'c}\Pi^C_{cm}\big(\{\mathcal{B}^o_m \cup \{gc, g'c\}\}, \cdot\big)\big] + D_g(gc, g'c)\tilde{\tau}_{gc}(\varepsilon) + D_{g'}(gc, g'c)\tilde{\tau}_{g'c}(\varepsilon)}_{\tilde{\Pi}^C(\varepsilon)} > 0,$$

where all profit changes are evaluated at prices $\boldsymbol{p}^o$ and affiliate fees $\boldsymbol{\tau}'$. Using (S.6) and our previously defined notation, the left-hand side of the previous inequality can be rewritten as

$$\begin{aligned}\tilde{\Pi}^C(\varepsilon) = E &- \big(\big[\Delta_{gc,g'c}\pi_g(gc, g'c)\big] - D_g(gc, g'c)\tilde{\tau}_{gc}(\varepsilon)\big) \\ &- \big(\big[\Delta_{gc,g'c}\pi_{g'}(gc, g'c)\big] - D_{g'}(gc, g'c)\tilde{\tau}_{gc}(\varepsilon)\big),\end{aligned} \tag{S.7}$$

where the terms subtracted from E on the right-hand side are the realized changes in g and g''s profits when both satellite distributors are supplied with c at affiliate fees $\{\tilde{\tau}_{gc}(\varepsilon), \tilde{\tau}_{g'c}(\varepsilon)\}$. Consider the following two cases:

- If $A_g \le B_g$, then

$$\begin{aligned}&\big[\Delta_{gc,g'c}\pi_g(gc, g'c)\big] - D_g(gc, g'c)\tilde{\tau}_{gc}(\varepsilon) \\ &\quad = \big[\Delta_{gc,g'c}\pi_g(gc, g'c)\big] \\ &\qquad - D_g(gc, g'c)\frac{\big[\Delta_{gc,g'c}\pi_g(gc, g'c)\big]}{D_g(gc, g'c)} + D_g(gc, g'c)\varepsilon \\ &\quad = D_g(gc, g'c)\varepsilon \\ &\quad \le D_g(gc, \emptyset)\varepsilon,\end{aligned} \tag{S.8}$$

where the first equality follows from substituting for $\tilde{\tau}_{gc}(\varepsilon)$ from (S.5), using the fact that $A_g \le B_g$; and the final inequality follows from g obtaining weakly more subscribers when g' does not carry c.

[6]For simplicity, we suppress the notation for the arguments of the profit functions; note, however, that, given bundle prices $\boldsymbol{p}^o$, the three-party-surplus is unaffected by the levels of $(\tau_{gc}, \tau_{g'c})$.

- If $A_g > B_g$, then for small enough $\varepsilon > 0$

$$
\begin{aligned}
&\big[\Delta_{gc,g'c}\pi_g\big(gc,g'c\big)\big] - D_g\big(gc,g'c\big)\tilde{\tau}_{gc}(\varepsilon) \\
&\quad = \big[\Delta_{g'c}\pi_g\big(gc,g'c\big)\big] + \big[\Delta_{gc}\pi_g(gc,\emptyset)\big] \\
&\qquad - \underbrace{\big(D_g\big(gc,g'c\big) - D_g(gc,\emptyset)\big)}_{[\Delta_{g'c}D_g(gc,g'c)]}\tilde{\tau}_{gc}(\varepsilon) - D_g(gc,\emptyset)\tilde{\tau}_{gc}(\varepsilon) \\
&\quad = \big[\Delta_{g'c}\pi_g\big(gc,g'c\big)\big] - \big[\Delta_{g'c}D_g\big(gc,g'c\big)\big]\tilde{\tau}_{gc}(\varepsilon) \\
&\qquad + \underbrace{\big[\Delta_{gc}\pi_g(gc,\emptyset)\big] - D_g(gc,\emptyset)\tilde{\tau}_{gc}(\varepsilon)}_{D_g(gc,\emptyset)\varepsilon} \\
&\quad = \Big[\sum_m \big[\Delta_{g'c}D_{gm}\big(gc,g'c\big)\big] \times \big(p_{gm}^{o,\text{pre-tax}} - mc_{gm}^o\big)\Big] \\
&\qquad - \big[\Delta_{g'c}D_g\big(gc,g'c\big)\big]\tilde{\tau}_{gc}(\varepsilon) + D_g(gc,\emptyset)\varepsilon \\
&\quad = \Big[\sum_m \underbrace{\big[\Delta_{g'c}D_{gm}\big(gc,g'c\big)\big]}_{\leq 0\ \forall m} \times \underbrace{\big(p_{gm}^{o,\text{pre-tax}} - mc_{gm}^o - \tilde{\tau}_{gc}(\varepsilon)\big)}_{>0\ \forall m}\Big] + D_g(gc,\emptyset)\varepsilon \\
&\quad \leq D_g(gc,\emptyset)\varepsilon,
\end{aligned}
\tag{S.9}
$$

where the fourth line follows from rearranging terms, and the last inequality holds under the positive margin condition.

Similar conclusions apply for g' when $A_{g'} \leq B_{g'}$ and when $A_{g'} > B_{g'}$.

Substituting the inequalities in (S.8) and (S.9) for both g and g' into (S.7) implies that

$$\tilde{\Pi}^C(\varepsilon) \geq E - \varepsilon \times \big(D_g(gc,\emptyset) + D_{g'}\big(\emptyset, g'c\big)\big).$$

Thus, if $\varepsilon > 0$, $\tilde{\Pi}^C(\varepsilon) > 0$ for any $\varepsilon \leq E/(D_g(gc,\emptyset) + D_{g'}(\emptyset, g'c))$, and channel c will find it profitable to make offers to g and g' that will be accepted.

REMARK: The idea behind this necessary condition is as follows. If a satellite distributor's willingness to pay for channel c is lowest when the rival satellite distributor also has access to channel c, then the affiliate fee offers described above make each satellite distributor slightly preferring to accept given that acceptance leads to both distributors getting the channel while rejection leads to neither distributor having it. As a result, if three-party-surplus from supply to both distributors is positive, channel c's profit would increase by making these offers. Suppose, instead, that a satellite distributor's willingness to pay for channel c is lowest when the rival satellite distributor does not have access to channel c. Then the above offers make the satellite distributor slightly preferring to accept if its rival does not have access. But, when its rival does gain access (which happens with these simultaneous offers), each satellite distributor's profit falls below its level when neither has access (given positive margins) and, again, three-party-surplus being positive implies that channel c's profit rises when both distributors accept.

S.B. MODELING AND ESTIMATION DETAILS

S.B.1. *Ownership and Control Shares*

We begin by defining the ownership variables O^M_{fct}, O^C_{fct}, and O^{CC}_{cdt} that we use in our estimation, then discuss the motivation behind these choices, and finally calculate our measures in a few examples.

Definitions. For any MVPD f and channels c and d, we define

$$O^M_{fct} \equiv \frac{\sum_{j\in\mathcal{O}_f}(o_{jft}\times o_{jct})/(o_{jft}+o_{jct})}{\sum_{j\in\mathcal{O}_f}(o_{jft})^2/(o_{jft}+o_{jct})},$$

$$O^C_{fct} \equiv \frac{\sum_{j\in\mathcal{O}_c}(o_{jct}\times o_{jft})/(o_{jct}+o_{jft})}{\sum_{j\in\mathcal{O}_c}(o_{jct})^2/(o_{jct}+o_{jft})},$$

$$O^{CC}_{cdt} \equiv \frac{\sum_{j\in\mathcal{O}_c}(o_{jct}\times o_{jdt})/(o_{jct}+o_{jdt})}{\sum_{j\in\mathcal{O}_c}(o_{jct})^2/(o_{jct}+o_{jdt})},$$

where $\mathcal{O}_g$ represents the set of owners of firm g (either MVPD or channel), o_{jgt} represents the ownership share of firm g by owner j, O^M_{fct} represents the ownership coefficient used by an MVPD f when weighting an integrated channel c's profits, O^C_{fct} represents the ownership coefficient used by a channel c when weighting an integrated MVPD f's profits, and O^{CC}_{cdt} represents the ownership coefficient used by a channel c when weighting the profits of a channel d's with which it shares a common owner.

Motivation. For the following discussion, assume that $\mu = 1$.

If vertical integration always involved full ownership, there would be no question of how to form firms' objective functions. The difficulty comes when there is partial ownership, such as when an MVPD buys a partial stake in an RSN. In that case, the various owners of the channel may have differing preferences over the actions that the channel should take. While some papers have proposed partial ownership measures (e.g., Bresnahan and Salop (1986), O'Brien and Salop (2000)), little is known empirically about how conflicting objectives among a firm's owners translates into the firm's behavior.

Our approach to this issue and resulting measures can be understood as follows: consider, as an example, a channel c that is partially owned by an MVPD f (and owned by no other entity with ownership stakes in another distributor or channel). Denote the channel-specific profits as π_c and MVPD-specific distribution profits as π_f. We assume that (the manager of) channel c maximizes an objective that is an ownership-share weighted average (with weights representing "shares of control") of its owners' "normalized" preferences over channel and MVPD distribution profits:

$$\begin{aligned}\tilde{\Pi}_{ct} &= \sum_j \underbrace{o_{jct}}_{\text{Ownership shares}} \underbrace{\left[\frac{o_{jct}}{o_{jct}+o_{jft}}\pi_c + \frac{o_{jft}}{o_{jct}+o_{jft}}\pi_f\right]}_{\text{Relative “cash flows”}} \\ &\propto \pi_c + O^C_{fct} \times \pi_f,\end{aligned} \tag{S.10}$$

where the normalization for each owner j places weights on π_c and π_f that sum to 1. Similar logic underlies the other ownership variables (O^M_{fct} and O^{CC}_{cdt}).

One can imagine various approaches to this issue. Our measures differ from those used in the literature cited above on partial ownership by normalizing cash flows for each owner (e.g., in (S.10), the weights on π_c and π_f for each owner j sum to 1), and in using ownership shares as the control weights. Recent work by Azar, Schmalz, and Tecu (2018), for example, uses ownership shares as control weights as we do, but does not normalize the cash flows. Absent this normalization, in the above example channel c would maximize instead an objective proportional to $\pi_c + \tilde{O}^C_{fct}\pi_f$, where $\tilde{O}^C_{fct} = (\sum_{j\in\mathcal{O}_c} o_{jct} \times o_{jft})/(\sum_{j\in\mathcal{O}_c} o^2_{jct})$. Of course, these two approaches do not exhaust the possibilities. For example, one could assume that a firm's owners bargain efficiently, resulting in behavior that maximizes their joint payoff. In that case, channel c would maximize an objective proportional to $\pi_c + \overline{O}^C_{fct}\pi_f$, where $\overline{O}^C_{fct} = (\sum_{j\in\mathcal{O}_c} o_{jft})/(\sum_{j\in\mathcal{O}_c} o_{jct})$.

One reason that we depart from these two approaches is that these other measures can lead to some counterintuitive predictions. For example, consider a situation in which an MVPD owns share x of channel c, while N other shareholders each own share $(1-x)/N$ of channel c and nothing else. In that case, $\tilde{O}^C_{fct} = x/(x^2+(1-x)^2/N)$, $\overline{O}^C_{fct} = 1$, and our measure is $O^C_{fct} = x$. As N goes to ∞, the first measure $\tilde{O}^C_{fct} \to 1/x$. That is, no matter how small the MVPD's ownership share x is, as N gets large the channel's behavior comes to be what the MVPD would want. The N shareholders with common interests are essentially powerless. Indeed, for small x, the channel simply maximizes the MVPD's distribution profits. This outcome puts even more weight on the MVPD's distribution profits than the jointly efficient weight $\overline{O}^C_{fct}$, which leads the channel to maximize $(\pi_c + \pi_f)$ regardless of how small the MVPD's ownership share x is. In contrast, in this example, our measure puts a weight on the MVPD's distribution profits that equals the MVPD's ownership share in the channel (which is less than the jointly efficient weight).

We next prove an important feature of our measure: if an MVPD and channel share at most a single common owner (i.e., an entity that has positive ownership stakes in both firms), then $O^M_{fct} = O^C_{fct}$.

LEMMA 3: *Consider MVPD f and channel c. If there exists at most one owner j such that $o_{jft} \times o_{jct} > 0$, then $O^M_{fct} = O^C_{fct}$.*

PROOF: Let $o_{jct} = x$ and $o_{jft} = y$. The numerators for O^M_{fct} and O^C_{fct} are equivalent. The denominator for O^M_{fct} equals $y^2/(x+y) + (1-y)$. The denominator for O^C_{fct} equals $x^2/(x+y) + (1-x)$. Both equal $(x+y-xy)/(x+y)$. *Q.E.D.*

This property holds for all MVPD and channel pairs that we consider in our analysis.

Finally, note one important empirical advantage of our measure O^C_{fct}: it is invariant to the distribution of ownership among owners with no ownership interests in any other firms within the industry. For example, in the above example, we would also have $O^C_{fct} = x$ if instead there was a single firm owning the $(1-x)$ share of channel c (and nothing else). As a result, we do not need data on the pattern of ownership except that among firms who are vertically integrated.

Examples. We provide two examples of our ownership variables.

1. *Unitary MVPD ownership.* Consider an MVPD f that owns $o_{fct} = x$ share of channel c. In this case, there is a single owner j of MVPD f, where $o_{jft} = 1$. Then the MVPD f places weight O^M_{fct} on channel c's profits (relative to its own profits) when making decisions, where

$$O^M_{fct} = \frac{(1 \times x)/(1+x)}{(1)/(1+x)} = x.$$

For the channel c, there are essentially two owners: one that owns $(1-x)$ of c (and none of MVPD f), and MVPD f that owns x of c. Here, channel c places weight O^C_{fct} on MVPD f's profits (relative to its own profits) when making decisions, where

$$O^C_{fct} = \frac{(x \times 1)/(1+x)}{(1-x)^2/(1-x) + (x)^2/(1+x)} = \frac{x}{(1+x)(1-x) + x^2} = x.$$

Thus, $O^M_{fct} = O^C_{fct}$ when a channel only has a single integrated owner.

2. *Channel Conglomerates.* Assume that a third party owns x share of channel c and y share of channel d. Then channel c places weight O^{CC}_{cdt} on channel d's profits (relative to its own profits) when making decisions, where

$$O^{CC}_{cdt} = \frac{(x \times y)/(x+y)}{(1-x)^2/(1-x) + (x)^2/(x+y)} = \frac{x \times y}{(x+y)(1-x) + x^2} = \frac{x \times y}{x + y - x \times y}.$$

S.B.2. *Solving for Negotiated Affiliate Fees and Bundle Marginal Costs*

We omit the subscript on $\Psi_{fct} \equiv (1-\zeta_{fct})/\zeta_{fct}$ for the expressions in this subsection. Let $\mathcal{B}^R_{fmt}$ be the observed set of RSNs carried by f in market m in period t.

Consider MVPD f bargaining with channel c over affiliate fee τ_{fct}, where c has at most a single integrated owner. Closed form expressions for MVPD and channel "GFT" terms in (9) are

$$\begin{aligned} \mathrm{GFT}^M_{fct} = \sum_{m \in \mathcal{M}_{fct}} \Bigg[& \big[\mu_{fct} D_{fmt} - D^{\setminus fc}_{fmt}\big]\tau_{fct} + \mu_{fct} \times \Bigg(D_{fmt} + \sum_{g \neq f : c \in \mathcal{B}_{gmt}} [\Delta_{fc} D_{gmt}] \Bigg) a_{cmt} \\ & + \mu_{fct} \sum_{g \neq f : c \in \mathcal{B}_{gmt}} [\Delta_{fc} D_{gmt}] \tau_{gct} \\ & + \sum_{d \in \mathcal{V}_{ft} \setminus c} \sum_{g \in \mathcal{F}_{mt} : d \in \mathcal{B}_{gmt}} [\Delta_{fc} D_{gmt}] \mu_{fdt} \times (\tau_{gdt} + a_{dmt}) \\ & + [\Delta_{fc} D_{fmt}] \big(p^{\text{pre-tax}}_{fmt} - mc_{fmt} \big) \Bigg], \end{aligned} \tag{S.11}$$

$$
\begin{aligned}
\mathrm{GFT}^{C}_{fct} = \sum_{m\in\mathcal{M}_{fct}} \Bigg[& \big(D_{fmt} - \mu_{fct} D^{\setminus fc}_{fmt}\big)\tau_{fct} + \Bigg(D_{fmt} + \sum_{g\neq f:c\in\mathcal{B}_{gmt}} [\Delta_{fc} D_{gmt}]\Bigg) a_{cmt} \\
& + \sum_{g\neq f:c\in\mathcal{B}_{gmt}} [\Delta_{fc} D_{gmt}](\tau_{gct}) \\
& + \sum_{g\in\mathcal{F}_{mt}} \lambda_{R:fct}[\Delta_{fc} D_{gmt}] \sum_{d\in\mathcal{B}_{gmt}\setminus c} \mu^{CC}_{cdt} \times (\tau_{gdt} + a_{dmt}) \\
& + \sum_{g\in\mathcal{F}_{mt}} \mu_{gct}\lambda_{R:fct}[\Delta_{fc} D_{gmt}]\big(p^{\text{pre-tax}}_{gmt} - mc_{gmt}\big)\Bigg],
\end{aligned} \tag{S.12}
$$

where $D^{\setminus fc}_{fmt}$ is the demand for f in market m if it dropped channel c; $\lambda_{R:fct} = \lambda_R$ if f and c are not integrated, and $\lambda_{R:fct} = 1$ otherwise; $\mu_{fct} = \mu \times O^M_{fct}$; $\mu^{CC}_{cdt} = \mu \times O^{CC}_{cdt}$; and $\mathcal{V}_{ft} \equiv \{c : O_{fct} > 0\}$ is the set of channels owned by MVPD f in period t.

Focus on the bargain between an RSN c and MVPD f.[7] Using (S.11) and (S.12), the Nash Bargaining first-order condition $\forall f \in \mathcal{F}_{mt}, c \in \mathcal{C}^R_t$ given by (10) ($\mathrm{GFT}^C_{fct} = \Psi\,\mathrm{GFT}^M_{fct}$) can be rewritten as

$$
\begin{aligned}
& \tau_{fct} \sum_{m\in\mathcal{M}_{fct}} \big[(1+\Psi)(1-\mu_{fct})D_{fmt}\big] + \sum_{g\neq f:c\in\mathcal{B}_{gmt}} \tau_{gct} \sum_{m\in\mathcal{M}_{fct}} (1-\Psi\mu_{fct})[\Delta_{fc} D_{gmt}] \\
& \quad + \sum_{g\in\mathcal{F}_{mt}} \sum_{d\in\mathcal{B}_{gmt}\setminus c} \tau_{gdt} \times \big((\Psi - \mu_{fct})\mathbb{1}_{g=f} + \mu^{CC}_{cdt} - \Psi\mu_{fdt}\big) \sum_{m\in\mathcal{M}_{fct}} [\Delta_{fc} D_{gmt}] \\
& \quad + (\Psi - \mu_{fct}) \sum_{m\in\mathcal{M}_{fct}} mc^{\setminus R}_{fmt}[\Delta_{fc} D_{fmt}] \\
& = \sum_{m\in\mathcal{M}_{fct}} \big[(\Psi - \mu_{fct})[\Delta_{fc} D_{fmt}] p^{\text{pre-tax}}_{fmt}\big] \\
& \quad - \sum_{m\in\mathcal{M}_{fct}} \Bigg[a_{cmt} \times \Bigg((1-\Psi\mu_{fct})D_{fmt} + (1-\Psi\mu_{fct}) \sum_{g\neq f:c\in\mathcal{B}_{gmt}} [\Delta_{fc} D_{gmt}]\Bigg) \\
& \quad + \sum_{g\in\mathcal{F}_{mt}} \sum_{d\in\mathcal{B}_{gmt}\setminus c} a_{dmt} \times \big(\mu^{CC}_{cdt} - \Psi\mu_{fdt}\big)\big([\Delta_{fc} D_{gmt}]\big)\Bigg],
\end{aligned} \tag{S.13}
$$

where $mc^{\setminus R}_{fmt}$ represents non-RSN marginal costs: that is, $mc^{\setminus R}_{fmt} \equiv mc_{fmt} - \sum_{d\in\mathcal{B}^R_{fmt}} \tau_{fdt}$.

[7] In estimation, we are assuming that $\lambda_R = 0$ in the "non-loophole" markets, and thus omit terms that would otherwise enter (e.g., if c were integrated with a rival MVPD f'). In the counterfactuals, we reintroduce these terms.

We can also rewrite the pricing first-order condition in (5), which provides the optimal set of prices for every cable provider f in every market m, as

$$\begin{aligned}&\sum_{g\in\mathcal{F}_{mt}}\frac{\partial D_{gmt}}{\partial p_{fmt}}\left(mc_{gmt}^{\setminus R}\mathbb{1}_{g=f}+\sum_{d\in\mathcal{B}_{gmt}^R}(\mathbb{1}_{g=f}-\mu_{fdt})\tau_{gdt}\right)\\&\quad=\left[\frac{D_{fmt}}{1+tax_{fmt}}+\frac{\partial D_{fmt}}{\partial p_{fmt}}p_{fmt}^{\text{pre-tax}}+\sum_{g\in\mathcal{F}_{mt}}\frac{\partial D_{gmt}}{\partial p_{fmt}}\sum_{d\in\mathcal{B}_{gmt}^R}\mu_{fdt}a_{dmt}\right].\end{aligned}\tag{S.14}$$

However, if f is a satellite provider (denoted $f\in\mathcal{F}^{\text{sat}}$), we assume that there is a single national price p_{ft} and non-RSN marginal cost $\hat{mc}_{fmt}^{\setminus R}$ that applies across all markets; this implies that there is only a single pricing first-order condition for satellite firms:

$$\begin{aligned}&\sum_m\sum_{g\in\mathcal{F}_{mt}}\frac{\partial D_{gmt}}{\partial p_{ft}}\left(mc_{gt}^{\setminus R}\mathbb{1}_{g=f}+\sum_{d\in\mathcal{B}_{gmt}^R}(\mathbb{1}_{g=f}-\mu_{fdt})\tau_{gdt}\right)\\&\quad=\sum_m\left(\frac{D_{fmt}}{1+\text{tax}_{fmt}}+\frac{\partial D_{fmt}}{\partial p_{ft}}p_{ft}^{\text{pre-tax}}+\sum_{g\in\mathcal{F}_{mt}}\frac{\partial D_{gmt}}{\partial p_{fmt}}\sum_{d\in\mathcal{B}_{gmt}^R}\mu_{fdt}a_{dmt}\right)\\&\quad\forall f\in\mathcal{F}^{\text{sat}}.\end{aligned}\tag{S.15}$$

Equations (S.13), (S.14), and (S.15) express affiliate fees and marginal costs as a function of demand parameters, prices, and advertising rates. We thus solve for the vector of RSN affiliate fees $\{\tau_{fct}\}_{\forall f,t,c\in\mathcal{C}_t^R}$ for all RSNs and non-RSN bundle marginal costs $\{mc_{fmt}^{\setminus R}\}_{\forall fmt}$ via matrix inversion when evaluating the objective for any parameter vector $\boldsymbol{\theta}$.

National Channels. We use our estimates of RSN affiliate fees and non-RSN bundle marginal costs to recover $\{\tau_{fct}\}_{\forall ft,c\notin\mathcal{C}_t^R}$ for non-RSN channels via matrix inversion on the following:

$$\begin{aligned}&\tau_{fct}\sum_{m\in\mathcal{M}_{fct}}\left[D_{fmt}+\Psi D_{fmt}^{\setminus fc}\right]+\sum_{g\neq f:c\in\mathcal{B}_{gmt}}\tau_{gct}\sum_{m\in\mathcal{M}_{fct}}[\Delta_{fc}D_{gmt}]\\&\quad=\sum_{m\in\mathcal{M}_{fct}}\left[\Psi\times[\Delta_{fc}D_{fmt}]\left(p_{fmt}^{\text{pre-tax}}-\hat{mc}_{fmt}\right)\right]\\&\qquad+\sum_{g\in\mathcal{F}_{mt}}\sum_{d\in\mathcal{B}_{gmt}\setminus c}\mu_{fdt}\Psi\hat{\tau}_{gdt}\sum_{m\in\mathcal{M}_{fct}}[\Delta_{fc}D_{gmt}]\\&\qquad-\sum_{m\in\mathcal{M}_{fct}}\left[a_{cmt}\times\left(D_{fmt}+\sum_{g\neq f:c\in\mathcal{B}_{gmt}}[\Delta_{fc}D_{gmt}]\right)\right.\\&\qquad\left.+\sum_{g\in\mathcal{F}_{mt}}\sum_{d\in\mathcal{B}_{gmt}\setminus c}a_{dmt}\times(-\Psi\mu_{fdt})\left([\Delta_{fc}D_{gmt}]\right)\right],\end{aligned}\tag{S.16}$$

where we construct estimates of each bundle's marginal costs from our recovered non-RSN marginal costs as follows: $\hat{mc}_{fmt}\equiv\hat{mc}_{fmt}^{\setminus R}+\sum_{d\in\mathcal{B}_{fmt}^R}\hat{\tau}_{fdt}$. We assume away integration incentives for non-RSNs so that $\mu_{fct}=0\ \forall ft,c\notin\mathcal{C}_t^R$.

S.B.3. *Further Estimation and Simulation Details*

Construction of Disagreement Payoffs. Computation of several moments in estimation require constructing values of $\Delta_{fc}[\Pi^M_{fmt}(\cdot)]$ and $\Delta_{fc}[\Pi^C_{cmt}(\cdot)]$ for each MVPD f and channel c that contract in each period. These gains from trade for each pair are functions of both agreement and disagreement profits. Profits from agreement (as a function of $\boldsymbol{\theta}$) are computed using (4) and (7) with observed prices and bundles. Consistent with our timing assumptions (i.e., bundle prices, channel carriage, and affiliate fees are simultaneously determined), profits from disagreement between MVPD f and channel c are computed by removing c from all bundles offered by f and holding fixed: (i) bundle prices for all cable and satellite MVPDs; (ii) carriage decisions for other MVPDs ($\mathcal{B}'_{gmt} = \mathcal{B}_{gmt}\ \forall g \neq f$); and (iii) affiliate fees $\hat{\tau}_{-fc,t}$ for all other MVPD-channel pairs.

Importance Sampling. We follow the importance sampling approach of Ackerberg (2009) to estimate our model. We begin by simulating 350 households per market from an initial distribution of random preferences, so that each household is characterized by a vector of preferences for each channel and satellite distributor. For each of these simulated households, we solve the viewership problem given by (1) for each downstream firm in the household's market. To evaluate candidate parameter vectors in the estimation objective function, we approximate the relevant integrals (e.g., for implied market shares or mean viewership by channel) by weighting the initial simulated households by the implied importance sampling weights that depend on the initial distribution and the candidate distribution. For example, if one were to draw from an $N(0, 1)$ distribution initially, and want to approximate the mean of an $N(0.5, 1)$ distribution, one would put relatively more weight on the initial draws near 0.5, and relatively less weight on negative draws.

The approximation is more accurate the closer is the initial distribution to the candidate distribution. Therefore, we iteratively updated the initial distribution several times through the process. That is, after moving in the parameter space to lower objective function values, we re-simulated an initial distribution from the distribution of preferences implied by the then current best parameter vector.

Estimation of Channel Decay Parameters. We allow for households to have variance in their values of ν^{S} in order to estimate this parameter using importance sampling. Without allowing for variance in ν^{S}, we would not be able to obtain any benefits of the importance sampling procedure, as we would have to resolve the viewership problem for each simulated household at each objective function valuation. We assume that households had a value of ν^{S} drawn from a normal distribution with a common mean and standard deviation of 0.015.

As discussed in footnote 56, we estimate ν^{S} on a coarse grid (with values contained in $\{0.8, 0.91, 0.95, 0.99\}$); the objective function was minimized for $\nu^{\mathrm{S}} = 0.95$. The computational difficulty of estimating ν^{S} using the same procedure as with ν^{NS} is the following: with positive variance in both ν^{S} and ν^{NS}, and given that values of channel viewership utilities $\boldsymbol{\rho}$ are independent of decay parameters, there would commonly be households whose parameter draws implied very unrealistic viewership patterns (e.g., spending 90% of their full day watching a single channel). Such outlier households would imply very inelastic demand for cable or satellite bundles, and consequently implausibly high markups in certain markets. Although these households would have negligible weight absent simulation error, memory and computational limitations prevented us from using more than 350 household simulations per market in estimation.

To examine the sensitivity of our results to different values of ν^{S}, we have also computed our counterfactual simulations using parameter estimates obtained when $\nu^{\mathrm{S}} = 0.91$ and

$\nu^{\mathrm{S}} = 0.99$. In both cases, we find that average simulated changes in surplus or welfare across all RSNs are not statistically different from those reported in Table V (which are computed using parameter estimates obtained when $\nu^{\mathrm{S}} = 0.95$); and our main findings do not change.

S.B.4. *Computing Counterfactual Equilibria*

For each RSN channel c and each integration scenario—no vertical integration, vertical integration with PARs, and vertical integration without PARs—we compute predicted outcomes in all of the RSN's relevant markets in 2007. We also recompute outcomes for the integration scenario that is "observed" in the data for each RSN.

We maintain the following assumptions: (i) if supplied, satellite distributors carry c in all of c's relevant markets; (ii) cable carriage decisions and affiliate fees for c are allowed to adjust, but those for all other channels are held fixed. In our main counterfactual results (reported in the main text and in Tables A.V–A.X), we allow only cable prices to adjust in each RSN's relevant markets and hold fixed national satellite prices at levels observed in the data. In a robustness test, we allow satellite prices to adjust under the assumption that they are set at the DMA level; results from this specification are reported in Table A.XI.

As discussed in the main text and in footnote 74, if we are examining the vertical integration scenario without PARs, we also allow for the channel's supply decision to adjust: for example, if RSN c is a cable-owned RSN (or is non-integrated and assigned a cable owner under the vertical integration scenarios), we compute outcomes under four "supply scenarios"—the channel is supplied to both satellite distributors, supplied to only DirecTV or Dish, or supplied to neither satellite distributor—and test which supply scenario is robust to deviations by the channel.

For each RSN c, integration scenario, supply scenario, and set of carriage disturbances $\{\Delta_{fc}\omega_{fmt}\}_{f,m}$,[8] we compute outcomes in all of the RSN's relevant markets by iterating over the following procedure until prices, fees, and carriage decisions converge:[9]

1. Given affiliate fees and carriage decisions, we update bundle prices for all cable (and satellite, when appropriate) distributors to maximize profits.

2. Given bundle prices and carriage decisions, we update affiliate fees $\{\tau^{\mathrm{CF}}_{fct}\}_f$ using the following system of equations:

$$\begin{aligned}
&\tau^{\mathrm{CF}}_{fct} \sum_{m\in\mathcal{M}_{fct}} \big[(1+\Psi)(1-\mu_{fct})D^{\mathrm{CF}}_{fmt}\big] \\
&\quad + \sum_{g\neq f: c\in\mathcal{B}^{R,\mathrm{CF}}_{gmt}} \tau^{\mathrm{CF}}_{gct} \sum_{m\in\mathcal{M}_{fct}} (1-\Psi\mu_{fct}-\mu_{gct}\lambda_R)\big[\Delta_{fc}D^{\mathrm{CF}}_{gmt}\big] \\
&\quad + \sum_{g\in\mathcal{F}_{mt}} \sum_{d\in\mathcal{B}^{R,\mathrm{CF}}_{gmt}\setminus c} \tau^{\mathrm{CF}}_{gdt} \times \big((\Psi-\mu_{fct})\mathbb{1}_{g=f} + \mu^{CC}_{cdt} - \Psi\mu_{fdt} - \mu_{gct}\lambda_R\big)
\end{aligned}$$

[8]We draw a vector of carriage disturbances $\{\Delta_{fc}\omega_{fmt}\}_{f,m}$ for all MVPDs and relevant markets for RSN c, where each element $\Delta_{fc}\omega_{fmt}$ is drawn from a truncated normal distribution with variance $4\hat{\sigma}^2_\omega$ to rationalize observed carriage decisions in the data given by (20). That is, for every market m where $c\in\mathcal{B}_{fmt}$, we draw $\Delta_{fc}\omega_{fmt}$ conditional on it being less than $\Delta_{fc}\pi^M_{fmt}(\mathcal{B}_{mt},\cdot)$; and for every market m where $c\notin\mathcal{B}_{fmt}$, we draw $\Delta_{fc}\omega_{fmt}$ conditional on it being greater than $\Delta_{fc}\pi^M_{fmt}(\mathcal{B}_{mt}\cup fc,\cdot)$. All counterfactuals outcomes are computed for and averaged over 10 sets of carriage disturbance draws.

[9]We iterate until the sum of absolute differences between all RSN affiliate fees and all downstream prices does not change by more than 10^{-3}.

$$
\begin{aligned}
&\times \sum_{m \in \mathcal{M}_{fct}} \left[\Delta_{fc} D_{gmt}^{\text{CF}}\right] \\
&= \sum_{m \in \mathcal{M}_{fct}} \left[(\Psi - \mu_{fct})\left(p_{fmt}^{\text{pre-tax,CF}} - \hat{mc}_{fmt}^{\setminus R}\right)\left[\Delta_{fc} D_{fmt}^{\text{CF}}\right]\right. \\
&\quad - \mu_{f'ct}\lambda_R \times \left(p_{f'mt}^{\text{pre-tax,CF}} - \hat{mc}_{f'mt}^{\setminus R}\right)\left[\Delta_{fc} D_{f'mt}^{\text{CF}}\right]\Big] \\
&\quad - \sum_{m \in \mathcal{M}_{fct}} \Bigg[a_{cmt} \times \Bigg((1 - \Psi\mu_{fct}) D_{fmt}^{\text{CF}} + (1 - \Psi\mu_{fct}) \sum_{g \neq f : c \in \mathcal{B}_{gmt}^{R,\text{CF}}} \left[\Delta_{fc} D_{gmt}^{\text{CF}}\right]\Bigg) \\
&\quad + \sum_{g \in \mathcal{F}_{mt}} \sum_{d \in \mathcal{B}_{gmt}^{R,\text{CF}} \setminus c} a_{dmt} \times \left(\mu_{cdt}^{CC} - \Psi\mu_{fdt}\right)\left(\left[\Delta_{fc} D_{gmt}^{\text{CF}}\right]\right)\Bigg] \quad \forall f, c,
\end{aligned}
\tag{S.17}
$$

where f and f' represent the MVPDs with which c is potentially integrated. Equation (S.17) differs from (S.13) insofar as we now allow for the possibility that $\lambda_R > 0$, and that c may be integrated with a rival MVPD f' when bargaining with f. We only update $\{\tau_{fct}\}_{\forall f}$ for the given channel c that is being examined, and not for other channels d that may be active in c's relevant markets.

3. Given bundle prices, affiliate fees, and carriage disturbances, we update carriage decisions by checking in each relevant market whether or not the cable distributor wishes to carry the channel using (20).

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