Online Appendix

A A model of the reverse auction under complete information

A.1 Example 1 imposing independently owned TV stations

We derive the set of equilibria for Example 1 in Section 3.1 whilst imposing that all TV stations are independently owned. Assuming a random tie-breaking rule for bids above 0 and below 900 in line with footnote 27, the profit of TV station 1 is

$$\pi_1(b_1, b_2, b_3) = \begin{cases} 0 & \text{if } \min\{b_1, b_2\} \geq 900 \vee \min\{b_1, b_3\} \geq 900 \\ & \quad \vee \min\{b_2, b_3\} \geq 900, \\ 0 & \text{if } b_1 > \max\{b_2, b_3\}, \\ \min\{\max\{b_2, b_3\}, 900\} - 100 & \text{if } b_1 < \max\{b_2, b_3\}, \\ \frac{1}{2}(\max\{b_2, b_3\} - 100) & \text{if } b_1 = \max\{b_2, b_3\} > \min\{b_2, b_3\}, \\ \frac{2}{3}(b_2 - 100) & \text{if } b_1 = b_2 = b_3 > 0, \\ -100 & \text{if } b_1 = b_2 = b_3 = 0, \end{cases}$$

where we assume that the relevant case is given by the first applicable if statement. In particular, the first if statement covers the case where the reverse auction fails at the outset because at least two TV stations bid 900 or more. Consequently, in the subsequent if statements at most one TV station bids 900 or more. In the second if statement, TV station 1 is first to opt to remain on the air. In the third if statement, TV station 1 is frozen as either TV station 2 or 3 is first to opt to remain on the air. The remaining if statements cover ties. The profits of the remaining TV stations are analogous.

In Tables S1-S7, we divide the strategy space of TV station 2 into 8 regions, namely $[0, 100)$, 100, $(100, 300)$, 300, $(300, 500)$, 500, $(500, 900)$, and $[900, \infty)$. We further divide the strategy spaces of TV stations 1 and 3 as needed to either show that there is no profitable deviation for any TV station (indicated by ✓ in the respective cell) or give an example of a profitable deviation.[S1] Combining the cells marked with ✓, the set of equilibria is as stated in equation (4).

Table S1: $b_2 \in [0, 100]$

$b_1 \setminus b_3$	$[0, b_2)$	$[b_2, 100]$	$(100, 500)$	$[500, \infty)$
$[0, b_2)$	$b_3 = 900$	$b_2 = 900$	$b_2 = 900$	✓
$[b_2, 300]$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	✓
$(300, 500)$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	$b_3 = 0$
$[500, \infty)$	✓	✓	$b_1 = 0$	$\max\{b_1, b_3\} = 0$

[S1] The notation $\max\{b_1, b_3\} = 0$ in Table S1 means that the TV station with the higher bid has a profitable deviation to zero, and similarly for the remaining tables.

Table S2: $b_2 \in (100, 300)$

$b_1 \setminus b_3$	$[0, b_2)$	$[b_2, 500)$	$[500, \infty)$
$[0, b_2)$	$b_3 = 900$	$b_2 = 900$	✓
$[b_2, 300]$	$b_2 = 900$	$b_2 = 900$	✓
$(300, 500)$	$b_2 = 900$	$b_2 = 900$	$b_3 = 0$
$[500, \infty)$	$b_1 = 0$	$b_1 = 0$	$\max\{b_1, b_3\} = 0$

Table S3: $b_2 = 300$

$b_1 \setminus b_3$	$[0, 300)$	$[300, 500)$	$[500, \infty)$
$[0, 300)$	✓	$b_2 = 900$	✓
300	$b_2 = 900$	$b_2 = 900$	✓
$(300, 500)$	$b_2 = 900$	$b_2 = 900$	$b_3 = 0$
$[500, \infty)$	$b_1 = 0$	$b_1 = 0$	$\max\{b_1, b_3\} = 0$

Table S4: $b_2 \in (300, 500)$

$b_1 \setminus b_3$	$[0, b_2)$	$[b_2, 500)$	$[500, \infty)$
$[0, b_2)$	✓	$b_2 = 900$	$b_3 = 0$
$[b_2, 500)$	$b_2 = 900$	$b_2 = 900$	$b_3 = 0$
$[500, \infty)$	$b_1 = 0$	$b_1 = 0$	$\max\{b_1, b_3\} = 0$

Table S5: $b_2 = 500$

$b_1 \setminus b_3$	$[0, 500)$	$[500, \infty)$
$[0, 500)$	✓	$b_3 = 0$
$[500, \infty)$	$b_1 = 0$	$\max\{b_1, b_3\} = 0$

Table S6: $b_2 \in (500, 900)$

$b_1 \setminus b_3$	$[0, 500]$	$(500, b_2]$	(b_2, ∞)
$[0, 500]$	✓	$b_2 = 0$	$b_3 = 0$
$(500, b_2]$	$b_2 = 0$	$b_2 = 0$	$b_3 = 0$
(b_2, ∞)	$b_1 = 0$	$b_1 = 0$	$\max\{b_1, b_3\} = 0$

Table S7: $b_2 \in [900, \infty)$

$b_1 \setminus b_3$	$[0, 500]$	$(500, 900)$	$[900, \infty)$
$[0, 500]$	✓	$b_2 = 0$	$b_2 = 0$
$(500, 900)$	$b_2 = 0$	$b_2 = 0$	$b_2 = 0$
$[900, \infty)$	$b_2 = 0$	$b_2 = 0$	✓

A.2 Example 1 with joint ownership

We derive the set of equilibria for Example 1 in Section 3.1. The profit of firm 1 owning TV stations 1 and 3 is

$$\pi_1(b_1,b_2,b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1,b_2\} \geq 900 \\ & \quad \vee \min\{b_1,b_3\} \geq 900 \\ & \quad \vee \min\{b_2,b_3\} \geq 900, \\ \min\{b_1,900\} - 300 & \text{if} \quad b_1 > \max\{b_2,b_3\}, \\ 2\min\{b_2,900\} - 400 & \text{if} \quad b_2 > \max\{b_1,b_3\}, \\ \min\{b_3,900\} - 100 & \text{if} \quad b_3 > \max\{b_1,b_2\}, \\ \frac{1}{2}(2b_2 - 400) + \frac{1}{2}(b_2 - 300) & \text{if} \quad b_1 = b_2 > b_3, \\ \frac{1}{2}(b_1 - 100) + \frac{1}{2}(b_1 - 300) & \text{if} \quad b_1 = b_3 > b_2, \\ \frac{1}{2}(2b_2 - 400) + \frac{1}{2}(b_2 - 100) & \text{if} \quad b_2 = b_3 > b_1, \\ \frac{1}{3}(2b_2 - 400) + \frac{1}{3}(b_2 - 100) + \frac{1}{3}(b_2 - 300) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -400 & \text{if} \quad b_1 = b_2 = b_3 = 0 \end{cases} \tag{S1}$$

and the profit of firm 2 owning TV station 2 is

$$\pi_2(b_1,b_2,b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1,b_2\} \geq 900 \vee \min\{b_1,b_3\} \geq 900 \\ & \quad \vee \min\{b_2,b_3\} \geq 900, \\ 0 & \text{if} \quad b_2 > \max\{b_1,b_3\}, \\ \min\{\max\{b_1,b_3\},900\} - 500 & \text{if} \quad b_2 < \max\{b_1,b_3\}, \\ \frac{1}{2}(\max\{b_1,b_3\} - 500) & \text{if} \quad b_2 = \max\{b_1,b_3\} > \min\{b_1,b_3\}, \\ \frac{2}{3}(b_1 - 500) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -500 & \text{if} \quad b_1 = b_2 = b_3 = 0, \end{cases}$$

where we again assume that the relevant case is given by the first applicable if statement.

In Tables S8-S10, we again divide the strategy spaces of firms 1 and 2 as needed to either show that there is no profitable deviation for any firm or give an example of a profitable deviation. Combining the cells marked with ✓, the set of equilibria is as stated in equation (5).

Table S8: $b_2 \in [0, 600)$

$b_1 \setminus b_3$	$[0, b_2)$	b_2	$(b_2, 900)$	$[900, \infty)$
$[0, b_2)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	✓
b_2	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	✓
$(b_2, 900)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	✓
$[900, \infty)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$

Table S9: $b_2 = 600$

$b_1 \setminus b_3$	$[0, 500]$	$(500, 600)$	600	$(600, 900)$	$[900, \infty)$
$[0, 500]$	✓	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 900)$	✓
$(500, 600)$	$b_2 = 0$	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 900)$	✓
600	$b_2 = 0$	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 900)$	✓
$(600, 900)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 900)$	✓
$[900, \infty)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 900)$	$(b_1, b_3) = (0, 900)$

Table S10: $b_2 \in (600, \infty)$

$b_1 \setminus b_3$	$[0, 500]$	$(500, b_2)$	b_2	$(b_2, 900)$	$[900, \infty)$
$[0, 500]$	✓	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$
$(500, b_2)$	$b_2 = 0$	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$
b_2	$b_2 = 0$	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$
$(b_2, 900)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$
$[900, \infty)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$

A.3 Example 1 with different reservation values

We derive the set of equilibria for Example 1 in Section 3.1 whilst replacing the reservation value of TV station 2 by $v_2 = 700$. We came back to this variant of Example 1 in Section B. The profit of firm 1 owning TV stations 1 and 3 is

$$\pi_1(b_1, b_2, b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1, b_2\} \geq 900 \\ & \quad \vee \min\{b_1, b_3\} \geq 900 \\ & \quad \vee \min\{b_2, b_3\} \geq 900, \\ \min\{b_1, 900\} - 300 & \text{if} \quad b_1 > \max\{b_2, b_3\}, \\ 2\min\{b_2, 900\} - 400 & \text{if} \quad b_2 > \max\{b_1, b_3\}, \\ \min\{b_3, 900\} - 100 & \text{if} \quad b_3 > \max\{b_1, b_2\}, \\ \frac{1}{2}(2b_2 - 400) + \frac{1}{2}(b_2 - 300) & \text{if} \quad b_1 = b_2 > b_3, \\ \frac{1}{2}(b_1 - 100) + \frac{1}{2}(b_1 - 300) & \text{if} \quad b_1 = b_3 > b_2, \\ \frac{1}{2}(2b_2 - 400) + \frac{1}{2}(b_2 - 100) & \text{if} \quad b_2 = b_3 > b_1, \\ \frac{1}{3}(2b_2 - 400) + \frac{1}{3}(b_2 - 100) + \frac{1}{3}(b_2 - 300) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -400 & \text{if} \quad b_1 = b_2 = b_3 = 0 \end{cases} \tag{S2}$$

and the profit of firm 2 owning TV station 2 is

$$\pi_2(b_1,b_2,b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1,b_2\} \geq 900 \vee \min\{b_1,b_3\} \geq 900 \\ & \qquad \vee \min\{b_2,b_3\} \geq 900, \\ 0 & \text{if} \quad b_2 > \max\{b_1,b_3\}, \\ \min\{\max\{b_1,b_3\},900\} - 700 & \text{if} \quad b_2 < \max\{b_1,b_3\}, \\ \frac{1}{2}(\max\{b_1,b_3\} - 700) & \text{if} \quad b_2 = \max\{b_1,b_3\} > \min\{b_1,b_3\}, \\ \frac{2}{3}(b_1 - 700) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -700 & \text{if} \quad b_1 = b_2 = b_3 = 0, \end{cases}$$

where we again assume that the relevant case is given by the first applicable if statement.

In Tables S11-S14, we again divide the strategy spaces of firms 1 and 2 as needed to either show that there is no profitable deviation for any firm or give an example of a profitable deviation. Combining the cells marked with ✓, the set of equilibria is

$$\begin{aligned} &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 < 900, b_2 \leq 600, b_3 \geq 900\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 \leq 700, b_2 > 700, b_3 \leq 700\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | \max\{b_1,b_3\} < b_2, 600 \leq b_2 \leq 700\right\}. \end{aligned}$$

Note that firm 1 never bids $b_3 = 900$ as long as firm 2 truthfully bids $b_2 = 700$.

Table S11: $b_2 \in [0,600)$

$b_1 \setminus b_3$	$[0,b_2)$	b_2	$(b_2,900)$	$[900,\infty)$
$[0,b_2)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	✓
b_2	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	✓
$(b_2,900)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	✓
$[900,\infty)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$	$(b_1,b_3)=(0,900)$

Table S12: $b_2 = 600$

$b_1 \setminus b_3$	$[0,600)$	$[600,900)$	$[900,\infty)$
$[0,600)$	✓	$(b_1,b_3)=(0,0)$	✓
$[600,900)$	$(b_1,b_3)=(0,0)$	$(b_1,b_3)=(0,0)$	✓
$[900,\infty)$	$(b_1,b_3)=(0,0)$	$(b_1,b_3)=(0,0)$	$(b_1,b_3)=(0,0)$

Table S13: $b_2 \in (600,700]$

$b_1 \setminus b_3$	$[0,b_2)$	$[b_2,\infty)$
$[0,b_2)$	✓	$(b_1,b_3)=(0,0)$
$[b_2,\infty)$	$(b_1,b_3)=(0,0)$	$(b_1,b_3)=(0,0)$

Table S14: $b_2 \in (700, \infty)$

$b_1 \setminus b_3$	$[0, 700]$	$(700, b_2)$	$[b_2, \infty)$
$[0, 700]$	✓	$b_2 = 0$	$(b_1, b_3) = (0, 0)$
$(700, b_2)$	$b_2 = 0$	$b_2 = 0$	$(b_1, b_3) = (0, 0)$
$[b_2, \infty)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$

A.4 Example 2 imposing independently owned TV stations

We derive the set of equilibria for Example 2 in Section 3.1 whilst imposing that all TV stations are independently owned. The profit of TV station 1 is

$$\pi_1(b_1, b_2, b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1, b_2\} \geq 900 \vee \min\{b_2, b_3\} \geq 900, \\ 0 & \text{if} \quad b_1 > \max\{b_2, b_3\}, \\ \min\{b_2, 900\} - 100 & \text{if} \quad b_2 > \max\{b_1, b_3\}, \\ 0 & \text{if} \quad b_3 > \max\{b_1, b_2\} \wedge b_1 > 0, \\ -100 & \text{if} \quad b_3 > \max\{b_1, b_2\} \wedge b_1 = 0, \\ \frac{1}{2}(b_2 - 100) & \text{if} \quad b_1 = b_2 > b_3, \\ 0 & \text{if} \quad b_1 = b_3 > b_2, \\ \frac{1}{2}(b_2 - 100) & \text{if} \quad b_2 = b_3 > b_1 > 0, \\ \frac{1}{2}(b_2 - 100) + \frac{1}{2}(-100) & \text{if} \quad b_2 = b_3 > b_1 = 0, \\ \frac{1}{3}(b_2 - 100) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -100 & \text{if} \quad b_1 = b_2 = b_3 = 0, \end{cases}$$

where we assume that the relevant case is given by the first applicable if statement. In particular, the first if statement covers the case where the reverse auction fails at the outset because either TV stations 1 and 2 or TV stations 2 and 3 bid 900 or more. Consequently, in the subsequent if statements at most a single TV station or TV stations 1 and 3 bid 900 or more. In the second if statement, TV station 1 is first to opt to remain on the air. In the third if statement, TV station 1 is frozen as TV station 2 is first to opt to remain on the air. In the fourth and fifth if statement, TV station 2 is frozen as TV station 3 is first to opt to remain on the air; then TV station 1 opts to remain on the air if $b_1 > 0$ or is frozen at the conclusion of the reverse auction if $b_1 = 0$ in line with footnote 29. The remaining if statements cover ties. The profit of TV station 2 is

$$\pi_2(b_1, b_2, b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1, b_2\} \geq 900 \vee \min\{b_2, b_3\} \geq 900, \\ 0 & \text{if} \quad b_2 > \max\{b_1, b_3\}, \\ 5\min\{\max\{b_1, b_3\}, 900\} - 1000 & \text{if} \quad b_2 < \max\{b_1, b_3\}, \\ \frac{1}{2}(5\max\{b_1, b_3\} - 1000) & \text{if} \quad b_2 = \max\{b_1, b_3\} > \min\{b_1, b_3\}, \\ \frac{2}{3}(5b_1 - 1000) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -1000 & \text{if} \quad b_1 = b_2 = b_3 = 0 \end{cases}$$

and the profit of TV station 3 is

$$\pi_3(b_1,b_2,b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1,b_2\} \geq 900 \vee \min\{b_2,b_3\} \geq 900, \\ 0 & \text{if} \quad b_3 > \max\{b_1,b_2\}, \\ \frac{1}{3}\min\{b_2,900\} - 100 & \text{if} \quad b_2 > \max\{b_1,b_3\}, \\ 0 & \text{if} \quad b_1 > \max\{b_2,b_3\} \wedge b_3 > 0, \\ -100 & \text{if} \quad b_1 > \max\{b_2,b_3\} \wedge b_3 = 0, \\ \frac{1}{2}\left(\frac{1}{3}b_2 - 100\right) & \text{if} \quad b_2 = b_3 > b_1, \\ 0 & \text{if} \quad b_1 = b_3 > b_2, \\ \frac{1}{2}\left(\frac{1}{3}b_2 - 100\right) & \text{if} \quad b_1 = b_2 > b_3 > 0, \\ \frac{1}{2}\left(\frac{1}{3}b_2 - 100\right) + \frac{1}{2}(-100) & \text{if} \quad b_1 = b_2 > b_3 = 0, \\ \frac{1}{3}\left(\frac{1}{3}b_2 - 100\right) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -100 & \text{if} \quad b_1 = b_2 = b_3 = 0. \end{cases}$$

In Tables S15-S23, we again divide the strategy spaces of the three TV stations as needed to either show that there is no profitable deviation for any firm or give an example of a profitable deviation. A blank cell indicates that the case cannot arise. Combining the cells marked with ✓, the set of equilibria is

$$\begin{aligned} &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 \leq 200, b_2 \geq 300, b_3 \leq 200\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 \geq 200, b_2 \leq 100, 0 < b_3 \leq 100\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 \geq 200, b_2 < b_3, 100 < b_3 < 200\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 > 0, b_2 < b_3, 200 \leq b_3 \leq 300\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 > 0, b_2 \leq 300, b_3 > 300\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 > b_2, 300 < b_2 < b_3 < 900\right\} \\ \cup &\left\{(b_1,b_2,b_3) \in [0,\infty)^3 | b_1 > b_2, 300 < b_2 < 900, b_3 \geq 900\right\}. \end{aligned}$$

Table S15: $b_3 = 0$

$b_1 \setminus b_2$	0	$(0,100)$	100	$(100,300)$ $b_1 \geq b_2$	$(100,300)$ $b_1 < b_2$	300	$(300,900)$	$[900,\infty)$
0	$b_2 = 900$	$b_3 = 900$	$b_3 = 900$		$b_3 = 900$	✓	✓	✓
$(0,100)$	$b_2 = 900$	$\min\{b_1,b_2\} = 900$	$b_3 = 900$		$b_3 = 900$	✓	✓	✓
100	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$		$b_3 = 900$	✓	✓	✓
$(100,200)$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	$b_3 = 900$	✓	✓	✓
200	$b_3 > 0$	$b_3 > 0$	$b_3 > 0$	$b_1 < 100$	$b_3 = 900$	✓	✓	✓
$(200,300)$	$b_3 > 0$	$b_3 > 0$	$b_3 > 0$	$b_1 < 100$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
300	$b_3 > 0$	$b_3 > 0$	$b_3 > 0$	$b_1 < 100$		$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(300,900)$	$b_3 > 0$	$b_3 > 0$	$b_3 > 0$	$b_1 < 100$		$b_1 < 300$	$\max\{b_1,b_2\} < 300$	$b_2 < 200$
$[900,\infty)$	$b_3 > 0$	$b_3 > 0$	$b_3 > 0$	$b_1 < 100$		$b_1 < 300$	$b_1 < 300$	$b_2 < 200$

Table S16: $b_3 \in (0, 100)$

$b_1 \setminus b_2$	$[0, b_3]$	$(b_3, 100)$	100	$(100, 300)$		300	$(300, 900)$	$[900, \infty)$
				$b_1 \geq b_2$	$b_1 < b_2$			
$[0, b_3]$	$b_2 = 900$	$b_3 = 900$	$b_3 = 900$		$b_3 = 900$	✓	✓	✓
$(b_3, 100)$	$b_2 = 900$	$\min\{b_1, b_2\} = 900$	$b_3 = 900$		$b_3 = 900$	✓	✓	✓
100	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$		$b_3 = 900$	✓	✓	✓
$(100, 200)$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	$b_3 = 900$	✓	✓	✓
200	✓	✓	✓	$b_1 < 100$	$b_3 = 900$	✓	✓	✓
$(200, 300)$	✓	✓	✓	$b_1 < 100$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
300	✓	✓	✓	$b_1 < 100$		$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(300, 900)$	✓	✓	✓	$b_1 < 100$		$b_1 < 300$	$\max\{b_1, b_2\} < 300$	$b_2 < 200$
$[900, \infty)$	✓	✓	✓	$b_1 < 100$		$b_1 < 300$	$b_1 < 300$	$b_2 < 200$

Table S17: $b_3 = 100$

$b_1 \setminus b_2$	$[0, 100]$	$(100, 300)$		300	$(300, 900)$	$[900, \infty)$
		$b_1 \geq b_2$	$b_1 < b_2$			
$[0, 100]$	$b_2 = 900$		$b_3 = 900$	✓	✓	✓
$(100, 200)$	$b_2 = 900$	$b_2 = 900$	$b_3 = 900$	✓	✓	✓
200	✓	$b_1 < 100$	$b_3 = 900$	✓	✓	✓
$(200, 300)$	✓	$b_1 < 100$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
300	✓	$b_1 < 100$		$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(300, 900)$	✓	$b_1 < 100$		$b_1 < 300$	$\max\{b_1, b_2\} < 300$	$b_2 < 200$
$[900, \infty)$	✓	$b_1 < 100$		$b_1 < 300$	$b_1 < 300$	$b_2 < 200$

Table S18: $b_3 \in (100, 200)$

$b_1 \setminus b_2$	$[0, b_3)$	b_3	$(b_3, 300)$		300	$(300, 900)$	$[900, \infty)$
			$b_1 \geq b_2$	$b_1 < b_2$			
$[0, b_3)$	$b_2 = 900$	$b_2 = 900$		$b_3 = 900$	✓	✓	✓
b_3	$b_2 = 900$	$b_2 = 900$		$b_3 = 900$	✓	✓	✓
$(b_3, 200)$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	$b_3 = 900$	✓	✓	✓
200	✓	$b_1 < 100$	$b_1 < 100$	$b_3 = 900$	✓	✓	✓
$(200, 300)$	✓	$b_1 < 100$	$b_1 < 100$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
300	✓	$b_1 < 100$	$b_1 < 100$		$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(300, 900)$	✓	$b_1 < 100$	$b_1 < 100$		$b_2 < 200$	$\max\{b_1, b_2\} < 300$	$b_2 < 200$
$[900, \infty)$	✓	$b_1 < 100$	$b_1 < 100$		$b_2 < 200$	$b_1 < 300$	$b_2 < 200$

Table S19: $b_3 = 200$

$b_1 \setminus b_2$	$[0, 200)$	200	$(200, 300)$	300	$(300, 900)$	$[900, \infty)$
0	$b_1 > 0$	$b_3 = 900$	$b_3 = 900$	✓	✓	✓
$(0, 200)$	✓	$b_3 = 900$	$b_3 = 900$	✓	✓	✓
200	✓	$b_3 = 900$	$b_3 = 900$	✓	✓	✓
$(200, 300)$	✓	$b_1 < 200$	$\max\{b_1, b_2\} < 200$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
300	✓	$b_1 < 200$	$b_1 < 200$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(300, 900)$	✓	$b_1 < 200$	$b_1 < 200$	$b_1 < 300$	$\max\{b_1, b_2\} < 300$	$b_2 < 200$
$[900, \infty)$	✓	$b_1 < 200$	$b_1 < 200$	$b_1 < 300$	$b_1 < 300$	$b_2 < 200$

Table S20: $b_3 \in (200, 300)$

$b_1 \setminus b_2$	$[0, b_3)$	b_3	$(b_3, 300)$	300	$(300, 900)$	$[900, \infty)$
0	$b_1 > 0$	$b_3 = 900$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(0, b_3)$	✓	$b_3 = 900$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
b_3	✓	$b_3 = 900$	$b_3 = 900$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(b_3, 300)$	✓	$b_1 < 200$	$\max\{b_1, b_2\} < 200$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
300	✓	$b_1 < 200$	$b_1 < 200$	$b_2 < 200$	$b_2 < 200$	$b_2 < 200$
$(300, 900)$	✓	$b_1 < 200$	$b_1 < 200$	$b_1 < 300$	$\max\{b_1, b_2\} < 300$	$b_2 < 200$
$[900, \infty)$	✓	$b_1 < 200$	$b_1 < 200$	$b_1 < 300$	$b_1 < 300$	$b_1 < 200$

Table S21: $b_3 = 300$

$b_1 \setminus b_2$	$[0, 300)$	300	$(300, 900)$	$[900, \infty)$
0	$b_1 > 0$	$b_2 < 300$	$b_2 < 300$	$b_2 < 300$
$(0, 300)$	✓	$b_2 < 300$	$b_2 < 300$	$b_2 < 300$
300	✓	$b_2 < 300$	$b_2 < 300$	$b_2 < 300$
$(300, 900)$	✓	$b_1 < 300$	$\max\{b_1, b_2\} < 300$	$b_2 < 300$
$[900, \infty)$	✓	$b_1 < 300$	$b_1 < 300$	$b_2 < 300$

Table S22: $b_3 \in (300, 900)$

$b_1 \setminus b_2$	$[0, 300]$	$(300, b_3)$		b_3	$(b_3, 900)$	$[900, \infty)$
		$b_1 > b_2$	$b_1 \le b_2$			
0	$b_1 > 0$		$b_3 < 300$	$b_3 < 300$	$b_2 < 300$	$b_2 < 300$
$(0, 300]$	✓		$b_3 < 300$	$b_3 < 300$	$b_2 < 300$	$b_2 < 300$
$(300, b_3)$	✓	✓	$b_3 < 300$	$b_3 < 300$	$b_2 < 300$	$b_2 < 300$
b_3	✓	✓	$b_2 < 300$	$b_2 < 300$	$b_2 < 300$	$b_2 < 300$
$(b_3, 900)$	✓	✓		$b_1 < 300$	$\max\{b_1, b_2\} < 300$	$b_2 < 300$
$[900, \infty)$	✓	✓		$b_1 < 300$	$b_1 < 300$	$b_2 < 300$

Table S23: $b_3 \in [900, \infty)$

$b_1 \setminus b_2$	$[0, 300]$	$(300, 900)$		$[900, \infty)$
		$b_1 > b_2$	$b_1 \leq b_2$	
0	$b_1 > 0$		$b_3 < 300$	$b_3 < 900$
$(0, 300]$	✓		$b_3 < 300$	$b_3 < 900$
$(300, 900)$	✓	✓	$b_3 < 300$	$b_3 < 900$
$[900, \infty)$	✓	✓		$b_2 < 900$

A.5 Example 2 with joint ownership

We derive the set of equilibria for Example 2 in Section 3.1. The profit of firm 1 owning TV stations 1 and 3 is

$$\pi_1(b_1, b_2, b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1, b_2\} \geq 900 \vee \min\{b_2, b_3\} \geq 900, \\ \frac{4}{3}\min\{b_2, 900\} - 200 & \text{if} \quad b_2 > \max\{b_1, b_3\}, \\ 0 & \text{if} \quad b_2 < \max\{b_1, b_3\} \wedge \min\{b_1, b_3\} > 0 \\ -100 & \text{if} \quad b_2 < \max\{b_1, b_3\} \wedge \min\{b_1, b_3\} = 0, \\ \frac{1}{2}\left(\frac{4}{3}b_2 - 200\right) & \text{if} \quad b_2 = \max\{b_1, b_3\} > \min\{b_1, b_3\} > 0, \\ \frac{1}{2}\left(\frac{4}{3}b_2 - 200\right) + \frac{1}{2}(-100) & \text{if} \quad b_2 = \max\{b_1, b_3\} > \min\{b_1, b_3\} = 0, \\ \frac{1}{3}\left(\frac{4}{3}b_2 - 200\right) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -200 & \text{if} \quad b_1 = b_2 = b_3 = 0, \end{cases}$$

and the profit of firm 2 owning TV station 2 is

$$\pi_2(b_1, b_2, b_3) = \begin{cases} 0 & \text{if} \quad \min\{b_1, b_2\} \geq 900 \vee \min\{b_2, b_3\} \geq 900, \\ 0 & \text{if} \quad b_2 > \max\{b_1, b_3\}, \\ 5\min\{\max\{b_1, b_3\}, 900\} - 1000 & \text{if} \quad b_2 < \max\{b_1, b_3\}, \\ \frac{1}{2}(5\max\{b_1, b_3\} - 1000) & \text{if} \quad b_2 = \max\{b_1, b_3\} > \min\{b_1, b_3\}, \\ \frac{2}{3}(5b_1 - 1000) & \text{if} \quad b_1 = b_2 = b_3 > 0, \\ -1000 & \text{if} \quad b_1 = b_2 = b_3 = 0, \end{cases}$$

where we again assume that the relevant case is given by the first applicable if statement.

In Tables S24-S28, we again divide the strategy spaces of the three TV stations as needed to either show that there is no profitable deviation for any firm or give an example of a profitable deviation. Combining the cells marked with ✓, the set of equilibria is

$$\begin{gathered} \left\{(b_1, b_2, b_3) \in [0, \infty)^3 \middle| \min\{b_1, b_3\} > 0, \max\{b_1, b_3\} \geq 200, b_2 \leq 150\right\} \\ \cup \left\{(b_1, b_2, b_3) \in [0, \infty)^3 \middle| \max\{b_1, b_3\} < b_2, 150 \leq b_2 \leq 200\right\} \\ \cup \left\{(b_1, b_2, b_3) \in [0, \infty)^3 \middle| \max\{b_1, b_3\} \leq 200, b_2 > 200\right\}. \end{gathered}$$

Table S24: $b_2 \in [0, 150)$

$b_1 \setminus b_3$	0	$(0, b_2]$	$(b_2, 200)$	$[200, \infty)$
0	$(b_1, b_3) = (900, 900)$	$(b_1, b_3) = (900, 900)$	$b_2 = 900$	$b_1 = 1$
$(0, b_2]$	$(b_1, b_3) = (900, 900)$	$(b_1, b_3) = (900, 900)$	$b_2 = 900$	✓
$(b_2, 200)$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	✓
$[200, \infty)$	$b_3 = 1$	✓	✓	✓

Table S25: $b_2 = 150$

$b_1 \setminus b_3$	0	$(0, 150)$	$[150, 200)$	$[200, \infty)$
0	✓	✓	$b_2 = 900$	$b_1 = 1$
$(0, 150)$	✓	✓	$b_2 = 900$	✓
$[150, 200)$	$b_2 = 900$	$b_2 = 900$	$b_2 = 900$	✓
$[200, \infty)$	$b_3 = 1$	✓	✓	✓

Table S26: $b_2 \in (150, 200]$

$b_1 \setminus b_3$	$[0, b_2)$	$[b_2, \infty)$
$[0, b_2)$	✓	$(b_1, b_3) = (0, 0)$
$[b_2, \infty)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$

Table S27: $b_2 \in (200, 900)$

$b_1 \setminus b_3$	$[0, 200]$	$(200, b_2]$	(b_2, ∞)
$[0, 200]$	✓	$b_2 < 200$	$(b_1, b_3) = (0, 0)$
$(200, b_2]$	$b_2 < 200$	$b_2 < 200$	$(b_1, b_3) = (0, 0)$
(b_2, ∞)	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$	$(b_1, b_3) = (0, 0)$

Table S28: $b_2 \in [900, \infty)$

$b_1 \setminus b_3$	$[0, 200]$	$(200, \infty)$
$[0, 200]$	✓	$b_2 < 200$
$(200, \infty)$	$b_2 < 200$	$b_2 < 200$

B A model of the reverse auction under incomplete information

We recast Example 1 in Section 3.1 as a game of incomplete information. We assume that the reservation value v_j of TV station j is privately known to its owner and specify another firm's belief about the reservation value of TV station j to be $\tilde{v}_j \sim N(v_j, \sigma^2)$, independent across TV stations.

The game of incomplete information gives rise to bidding functions, rather than bids, that depend on beliefs. As beliefs depend on σ, note that as σ goes to zero, beliefs collapse to the true reservation values. In this way, we are able to ascertain the relationship between bidding functions under the game of incomplete information and bids under the game of complete information. In the game of incomplete information, let $b_1(v_1, v_3, \sigma) \geq 0$ and $b_3(v_1, v_3, \sigma) \geq 0$ be the bidding functions of TV stations 1 and 3 that are owned by firm 1 and $b_2(v_2, \sigma) \geq 0$ the bidding function of TV station 2 that is owned by firm 2. In what follows, we characterize the bidding functions as $\sigma \to 0^+$. We show that firm 1 always bids $b_1 < b_3$. Its expected profit depends solely on b_3 and, as $\sigma \to 0^+$, closely resembles its profit under complete information. Moreover, for a wide range of values of σ, $b_3(100, 300, \sigma)$ is arbitrarily close to (but different from) $b_3 = 900$. Close to extreme overbidding thus arises in the game of incomplete information. In a variant of Example 1, we also show that close to extreme overbidding arises in the game of incomplete information when σ is large. In contrast, extreme overbidding does not arise in the game of complete information. Taken together, these results suggest that our notion of strategic supply reduction in settings with jointly owned TV stations extends beyond complete information.

To recast Example 1 as a game of incomplete information, note that expected profit of firm 1 if it bids $b_1 \geq 0$ and $b_3 \geq 0$ is

$$\begin{aligned} E\pi_1(b_1, b_3; v_1, v_3, \sigma) &= \int_{\tilde{v}_2} (PO_1(b_1, b_2(\tilde{v}_2, \sigma), b_3) - v_1)\, 1\,(1 \in F^*(b_1, b_2(\tilde{v}_2, \sigma), b_3)) \\ &\quad + (PO_3(b_1, b_2(\tilde{v}_2, \sigma), b_3) - v_3)\, 1\,(3 \in F^*(b_1, b_2(\tilde{v}_2, \sigma), b_3))\, d\Phi_2(\tilde{v}_2), \end{aligned}$$

where $1(\cdot)$ is the indicator function and $\tilde{v}_2$ is distributed according to the cumulative distribution function $\Phi_2(\tilde{v}_2) = \Phi\left(\frac{\tilde{v}_2 - v_2}{\sigma}\right)$ with $\Phi(\cdot)$ being the standard normal cumulative distribution function. As firm 1 bids optimally, the bidding functions are given by $(b_1(v_1, v_3, \sigma), b_3(v_1, v_3, \sigma)) = \arg\max_{b_1, b_3 \geq 0} E\pi_1(b_1, b_3; v_1, v_3, \sigma)$. The expected profit of firm 2 if it bids $b_2 \geq 0$ is

$$\begin{aligned} E\pi_2(b_2; v_2, \sigma) &= \int_{\tilde{v}_1} \int_{\tilde{v}_3} (PO_2(b_1(\tilde{v}_1, \tilde{v}_3, \sigma), b_2, b_3(\tilde{v}_1, \tilde{v}_3, \sigma)) - v_2) \\ &\quad \cdot 1\,(2 \in F^*(b_1(\tilde{v}_1, \tilde{v}_3, \sigma), b_2, b_3(\tilde{v}_1, \tilde{v}_3, \sigma)))\, d\Phi_3(\tilde{v}_3) d\Phi_1(\tilde{v}_1). \end{aligned}$$

As firm 2 bids optimally, the bidding function is given by $b_2(v_2, \sigma) = \arg\max_{b_2 \geq 0} E\pi_2(b_2; v_2, \sigma)$.

In the interest of simplicity, we restrict $b_j \leq 900$ and consider the nine possible bid configurations in Table S29.[S2] We determine $F^*(b)$ and $PO_j(b)$ from the bid configuration along with the specification of $S(X, R)$ in equation (2), assuming a random tie-breaking rule for bids above 0 and below 900 in line with footnote 27. The expected profit of firm 1 if it bids $b_1 \in [0, 900]$ and

[S2] While restricting $b_j \leq 900$ restricts the set of equilibria, it does not restrict the payouts to TV stations associated with these equilibria.

Table S29: Possible bid configurations

	TV station 1		TV station 2		TV station 3	
Bid configuration	$\Pr(1 \in F^*(b))$	$PO_1(b)$	$\Pr(2 \in F^*(b))$	$PO_2(b)$	$\Pr(3 \in F^*(b))$	$PO_3(b)$
$\min\{b_1, b_2\} = 900$ $\vee \min\{b_1, b_3\} = 900$ $\vee \min\{b_2, b_3\} = 900$	0	0	0	0	0	0
$b_1 > \max\{b_2, b_3\}$	0	0	1	b_1	1	b_1
$b_2 > \max\{b_1, b_3\}$	1	b_2	0	0	1	b_2
$b_3 > \max\{b_1, b_2\}$	1	b_3	1	b_3	0	0
$900 > b_1 = b_2 > b_3$	$\frac{1}{2}$	$b_1 \vee 0$	$\frac{1}{2}$	$b_1 \vee 0$	1	b_1
$900 > b_1 = b_3 > b_2$	$\frac{1}{2}$	$b_1 \vee 0$	1	b_1	$\frac{1}{2}$	$b_1 \vee 0$
$900 > b_2 = b_3 > b_1$	1	b_2	$\frac{1}{2}$	$b_2 \vee 0$	$\frac{1}{2}$	$b_2 \vee 0$
$900 > b_1 = b_2 = b_3 > 0$	$\frac{2}{3}$	$b_1 \vee 0$	$\frac{2}{3}$	$b_1 \vee 0$	$\frac{2}{3}$	$b_1 \vee 0$
$b_1 = b_2 = b_3 = 0$	1	0	1	0	1	0

$b_3 \in [0, 900]$ is

$$\begin{aligned}
E\pi_1(b_1, b_3; v_1, v_3, \sigma) &= \int_{\tilde{v}_2} (b_1 - v_3)\, 1\left(b_1 > \max\{b_2(\tilde{v}_2, \sigma), b_3\}\right) \\
&\quad + (2b_2(\tilde{v}_2, \sigma) - v_1 - v_3)\, 1\left(b_2(\tilde{v}_2, \sigma) > \max\{b_1, b_3\}\right) \\
&\quad + (b_3 - v_1)\, 1\left(b_3 > \max\{b_1, b_2(\tilde{v}_2, \sigma)\}\right) \\
&\quad + \left(\frac{1}{2}(b_3 - v_1) + \frac{1}{2}(b_1 - v_3)\right) 1\left(900 > b_1 = b_3 > b_2(\tilde{v}_2, \sigma)\right) \\
&\quad - (v_1 + v_3)\, 1\left(b_1 = b_2(\tilde{v}_2, \sigma) = b_3 = 0\right) d\Phi_2(\tilde{v}_2),
\end{aligned}$$

where we anticipate that in equilibrium firm 2's bid does not have mass points above 0 and below 900 and therefore, from firm 1's perspective, cannot tie with firm 1's bids in this range.

The expected profit of firm 2 if it bids $b_2 \in [0, 900]$ is

$$\begin{aligned}
E\pi_2(b_2; v_2, \sigma) &= \int_{\tilde{v}_1} \int_{\tilde{v}_3} (b_1(\tilde{v}_1, \tilde{v}_3, \sigma) - v_2)\, 1\left(b_1(\tilde{v}_1, \tilde{v}_3, \sigma) > \max\{b_2, b_3(\tilde{v}_1, \tilde{v}_3, \sigma)\}\right) \\
&\quad + (b_3(\tilde{v}_1, \tilde{v}_3, \sigma) - v_2)\, 1\left(b_3(\tilde{v}_1, \tilde{v}_3, \sigma) > \max\{b_1(\tilde{v}_1, \tilde{v}_3, \sigma), b_2\}\right) \\
&\quad + \frac{1}{2}(b_1(\tilde{v}_1, \tilde{v}_3, \sigma) - v_2)\, 1\left(900 > b_1(\tilde{v}_1, \tilde{v}_3, \sigma) = b_2 > b_3(\tilde{v}_1, \tilde{v}_3, \sigma)\right) \\
&\quad + (b_1(\tilde{v}_1, \tilde{v}_3, \sigma) - v_2)\, 1\left(900 > b_1(\tilde{v}_1, \tilde{v}_3, \sigma) = b_3(\tilde{v}_1, \tilde{v}_3, \sigma) > b_2\right) \\
&\quad + \frac{1}{2}(b_3(\tilde{v}_1, \tilde{v}, \sigma_3) - v_2)\, 1\left(900 > b_2 = b_3(\tilde{v}_1, \tilde{v}_3, \sigma) > b_1(\tilde{v}_1, \tilde{v}_3, \sigma)\right) \\
&\quad + \frac{2}{3}(b_1(\tilde{v}_1, \tilde{v}_3, \sigma) - v_2)\, 1\left(900 > b_1(\tilde{v}_1, \tilde{v}_3, \sigma) = b_2 = b_3(\tilde{v}_1, \tilde{v}_3, \sigma) > 0\right) \\
&\quad - v_2 1\left(b_1(\tilde{v}_1, \tilde{v}_3, \sigma) = b_2 = b_3(\tilde{v}_1, \tilde{v}_3, \sigma) = 0\right) d\Phi_3(\tilde{v}_3) d\Phi_1(\tilde{v}_1).
\end{aligned}$$

Inspection of the expected profit of firm 2 almost immediately yields

Proposition 5. *Truthful bidding* $b_2(v_2, \sigma) = \max\{\min\{v_2, 900\}, 0\}$ *is a dominant strategy for firm 2.*

Proof. We show that for any given values of $b_1(\tilde{v}_1, \tilde{v}_3, \sigma)$ and $b_3(\tilde{v}_1, \tilde{v}_3, \sigma)$, firm 2 cannot do better than bid $b_2(v_2, \sigma) = \max\{\min\{v_2, 900\}, 0\}$. We proceed by enumerating the different possible cases for $b_1(\tilde{v}_1, \tilde{v}_3, \sigma)$, $b_3(\tilde{v}_1, \tilde{v}_3, \sigma)$, and v_2. We restrict attention to cases where $b_1(\tilde{v}_1, \tilde{v}_3, \sigma) \geq b_3(\tilde{v}_1, \tilde{v}_3, \sigma)$ because cases where $b_1(\tilde{v}_1, \tilde{v}_3, \sigma) \leq b_3(\tilde{v}_1, \tilde{v}_3, \sigma)$ are analogous. For each case, Table S30 lists the best response of firm 2. A blank cell indicates that the case cannot arise. As can be seen from Table S30, the best response contains $\max\{\min\{v_2, 900\}, 0\}$ for each case, thereby establishing the proposition.

Table S30: Best response of firm 2

	(1) $v_2 > 900$	(2) $v_2 = 900$	(3) $900 > v_2 > b_1$	(4) $900 > v_2 = b_1 > 0$	(5) $v_2 = b_1 = 0$	(6) $v_2 < b_1$
$900 = b_1 > b_3 > 0$	900	$[0, 900]$				$[0, b_1)$
$900 > b_1 > b_3 > 0$	$(b_1, 900]$	$(b_1, 900]$	$(b_1, 900]$	$[0, 900]$		$[0, b_1)$
$900 = b_1 > b_3 = 0$	900	$[0, 900]$				$[0, b_1)$
$900 > b_1 > b_3 = 0$	$(b_1, 900]$	$(b_1, 900]$	$(b_1, 900]$	$[0, 900]$		$[0, b_1)$
$900 = b_1 = b_3$	900	$[0, 900]$				$[0, b_1)$
$900 > b_1 = b_3 > 0$	$(b_1, 900]$	$(b_1, 900]$	$(b_1, 900]$	$[0, 900]$		$[0, b_1)$
$b_1 = b_3 = 0$	$(0, 900]$	$(0, 900]$	$(0, 900]$		$[0, 900]$	

In column (1) of Table S30, firm 2 prefers not to sell TV station 2 at the opening price of 900. Firm 2 therefore either causes the reverse auction to fail at the outset if $b_1 = 900$ or withdraws first if $b_1 < 900$. In column (2), firm 2 is indifferent between selling TV station 2 at the opening price of 900 and not selling it. Firm 2 therefore bids anything if $b_1 = 900$ or withdraws first if $b_1 < 900$. In column (3), firm 2 prefers not to sell TV station 2 at a price of b_1. Firm 2 therefore withdraws first. In column (4) and (5), firm 2 is indifferent between selling TV station 2 at a price of b_1 and not selling it. Firm 2 therefore bids anything. In column (6), firm 2 prefers to sell TV station 2 at a price of b_1. Firm 2 therefore does not withdraw first. $\square$

Using Proposition 5, the expected profit of firm 1 if it bids $b_1 \in [0, 900]$ and $b_3 \in [0, 900]$ can be written as

$$
\begin{aligned}
E\pi_1(b_1, b_3; v_1, v_3, \sigma) \;=\; & \int_{900}^{\infty} (2 \cdot 900 - v_1 - v_3)\, 1\,(900 > \max\{b_1, b_3\})\, d\Phi_2(\tilde{v}_2) \\
& + \int_0^{900} (b_1 - v_3)\, 1\,(b_1 > \max\{\tilde{v}_2, b_3\}) \\
& + (2\tilde{v}_2 - v_1 - v_3)\, 1\,(\tilde{v}_2 > \max\{b_1, b_3\}) \\
& + (b_3 - v_1)\, 1\,(b_3 > \max\{b_1, \tilde{v}_2\}) \\
& + \left(\frac{1}{2}(b_3 - v_1) + \frac{1}{2}(b_1 - v_3)\right) 1\,(900 > b_1 = b_3 > \tilde{v}_2)\, d\Phi_2(\tilde{v}_2) \\
& + \int_{-\infty}^{0} (b_1 - v_3)\, 1\,(b_1 > b_3) \\
& + (b_3 - v_1)\, 1\,(b_3 > b_1) \\
& + \left(\frac{1}{2}(b_3 - v_1) + \frac{1}{2}(b_1 - v_3)\right) 1\,(900 > b_1 = b_3 > 0) \\
& - (v_1 + v_3)\, 1\,(b_1 = b_3 = 0)\, d\Phi_2(\tilde{v}_2). \qquad \text{(S3)}
\end{aligned}
$$

We assume $v_1 = 100$ and $v_3 = 300$ as in Table 1. Towards determining $b_1(100, 300, \sigma)$ and $b_3(100, 300, \sigma)$, the following propositions show that firm 1 always bids $b_1 < b_3$.

Proposition 6. *$E\pi_1(0, 0; 100, 300, \sigma) < E\pi_1(0, \epsilon; 100, 300, \sigma)$ and $E\pi_1(b, b; 100, 300, \sigma) < E\pi_1(b - \epsilon, b; 100, 300, \sigma)$ for all $b \in (0, 900]$ for any sufficiently small $\epsilon > 0$.*

Hence, firm 1 never bids $b_1 = b_3$.

Proof. First, consider $b = 0$. Then plugging into equation (S3) yields

$$
\begin{aligned}
E\pi_1(0, 0; 100, 300, \sigma) \;=\; & \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
& + \int_0^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
& - \int_{-\infty}^{0} (100 + 300)\, d\Phi_2(\tilde{v}_2) \\
< \; & \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
& + \int_{\epsilon}^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
& + \int_{-\infty}^{\epsilon} (\epsilon - 100)\, d\Phi_2(\tilde{v}_2) \\
= \; & E\pi_1(0, \epsilon; 100, 300, \sigma)
\end{aligned}
$$

for any sufficiently small $\epsilon > 0$. Consider next $b \in (0, 900)$. Then plugging into equation (S3) yields

$$
\begin{aligned}
E\pi_1(b, b; 100, 300, \sigma) &= \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{b}^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{-\infty}^{b} \left(b - \frac{1}{2}100 - \frac{1}{2}300\right) d\Phi_2(\tilde{v}_2) \\
&< \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{b}^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{-\infty}^{b} (b - 100)\, d\Phi_2(\tilde{v}_2) \\
&= E\pi_1(b - \epsilon, b; 100, 300, \sigma).
\end{aligned}
$$

Finally, consider $b = 900$. Then plugging into equation (S3) yields

$$
\begin{aligned}
E\pi_1(900, 900; 100, 300, \sigma) &= 0 \\
&< \int_{-\infty}^{900} (900 - 100) d\Phi_2(\tilde{v}_2) \\
&= E\pi_1(900 - \epsilon, 900; 100, 300, \sigma).
\end{aligned}
$$

□

Proposition 7. $b_1 > b_3$ implies $E\pi_1(b_1, b_3; 100, 300, \sigma) > E\pi_1(b_3, b_1; 100, 300, \sigma)$.

Hence, firm 1 never bids $b_1 > b_3$. Taken together, Propositions 6 and 7 imply that firm 1 always bids $b_1 < b_3$.

Proof. Consider first $900 > b_1 > b_3 \geq 0$. Then plugging into equation (S3) yields

$$
\begin{aligned}
E\pi_1(b_1, b_3; 100, 300, \sigma) &= \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{b_1}^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{-\infty}^{b_1} (b_1 - 300)\, d\Phi_2(\tilde{v}_2) \\
&< \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{b_1}^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{-\infty}^{b_1} (b_1 - 100)\, d\Phi_2(\tilde{v}_2) \\
&= E\pi_1(b_3, b_1; 100, 300, \sigma).
\end{aligned}
$$

Next consider $900 = b_1 > b_3 \geq 0$. Then plugging into equation (S3) yields

$$
\begin{aligned}
E\pi_1(900, b_3; 100, 300, \sigma) &= \int_{-\infty}^{900} (900 - 300)\, d\Phi_2(\tilde{v}_2) \\
&< \int_{-\infty}^{900} (900 - 100)\, d\Phi_2(\tilde{v}_2) \\
&= E\pi_1(b_3, 900; 100, 300, \sigma).
\end{aligned}
$$

$\square$

Using Propositions 6 and 7, the expected profit of 1 firm if $b_3 < 900$ becomes

$$
\begin{aligned}
E\pi_1(b_1, b_3; 100, 300, \sigma) &= \int_{900}^{\infty} (2 \cdot 900 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{b_3}^{900} (2\tilde{v}_2 - 100 - 300)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{0}^{b_3} (b_3 - 100)\, d\Phi_2(\tilde{v}_2) \\
&\quad + \int_{-\infty}^{0} (b_3 - 100)\, d\Phi_2(\tilde{v}_2) \\
&= 1400 \left(1 - \Phi\left(\frac{900 - v_2}{\sigma}\right)\right) \\
&\quad + (2v_2 - 400)\left(\Phi\left(\frac{900 - v_2}{\sigma}\right) - \Phi\left(\frac{b_3 - v_2}{\sigma}\right)\right) \\
&\quad + 2\sigma\left(\phi\left(\frac{b_3 - v_2}{\sigma}\right) - \phi\left(\frac{900 - v_2}{\sigma}\right)\right) \\
&\quad + (b_3 - 100)\,\Phi\left(\frac{b_3 - v_2}{\sigma}\right)
\end{aligned} \tag{S4}
$$

and

$$\begin{aligned} E\pi_1(b_1, 900; 100, 300, \sigma) &= \int_{-\infty}^{900} (900 - 100)\, d\Phi_2(\tilde{v}_2) \\ &= 800\Phi\left(\frac{900 - v_2}{\sigma}\right) \end{aligned}$$

if $b_3 = 900$. Note that the expected profit of firm 1 depends solely on b_3; hence, $b_1 \in [0, b_3)$ is indeterminate. Note also that $\lim_{b_3 \to 900-} E\pi_1(b_1, b_3; 100, 300, \sigma) > E\pi_1(b_1, 900; 100, 300, \sigma)$; hence, firm 1 never bids $b_3 = 900$.

To explore the relationship between the game of incomplete information as $\sigma \to 0^+$ so that beliefs collapse at the true reservation values and the game of complete information, we first assume $v_2 = 500$ as in Table 1. The expected profit of firm 1 in the game of incomplete information becomes

$$\begin{aligned} & E\pi_1(b_1, b_3; 100, 300, \sigma) \\ = & \begin{cases} 1400 - 800\Phi\left(\frac{400}{\sigma}\right) + (b_3 - 700)\,\Phi\left(\frac{b_3 - 500}{\sigma}\right) + 2\sigma\left(\phi\left(\frac{b_3 - 500}{\sigma}\right) - \phi\left(\frac{400}{\sigma}\right)\right) & \text{if} \quad b_3 < 900, \\ 800\Phi\left(\frac{400}{\sigma}\right) & \text{if} \quad b_3 = 900. \end{cases} \end{aligned} \tag{S5}$$

For comparison, in the game of complete information the profit of firm 1 in equation (S1) in Online Appendix A.2 becomes

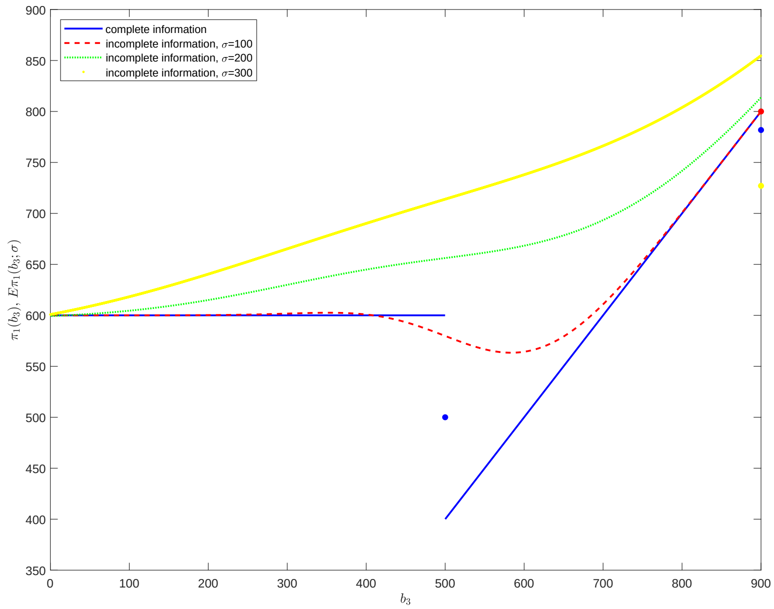
$$\pi_1(b_1, 500, b_3) = \begin{cases} 600 & \text{if} \quad b_3 < 500, \\ b_3 - 100 & \text{if} \quad b_3 > 500, \\ 500 & \text{if} \quad b_3 = 500, \end{cases} \tag{S6}$$

where we assume that firm 2 truthfully bids $b_2 = 500$ and firm 1 bids $b_1 < b_3$ as in the game of incomplete information. Note that in the game of complete information the profit of firm 1 again depends solely on b_3 and that firm 1 always bids such that $b_3 = 900$.

Figure S1 plots the expected profit of firm 1 in equation (S5) for various values of σ and the profit of firm 1 in equation (S6). As $\sigma \to 0^+$, the expected profit of firm 1 under incomplete information closely resembles the profit of firm 1 under complete information. Moreover, for a wide range of values of σ, $b_3(100, 300, \sigma)$ in the game of incomplete information is arbitrarily close to (but different from) $b_3 = 900$ in the game of complete information. Close to extreme overbidding thus arises in the game of incomplete information.

To further explore the relationship between the games of complete and incomplete information, we consider a variant of Example 1 in Online Appendix A.3 in which we replace the reservation value of TV station 2 by $v_2 = 700$. The expected profit of firm 1 in the game of incomplete information becomes

Figure S1: Expected profit and profit of firm 1 in equations (S5) and (S6) with $v_2 = 500$



$$
\begin{aligned}
&E\pi_1(b_1, b_3; 100, 300, \sigma) \\
&= \begin{cases} 1400 - 400\Phi\left(\frac{200}{\sigma}\right) + (b_3 - 1100)\,\Phi\left(\frac{b_3-700}{\sigma}\right) + 2\sigma\left(\phi\left(\frac{b_3-700}{\sigma}\right) - \phi\left(\frac{200}{\sigma}\right)\right) & \text{if} \quad b_3 < 900, \\ 800\Phi\left(\frac{200}{\sigma}\right) & \text{if} \quad b_3 = 900. \end{cases}
\end{aligned}
\tag{S7}
$$

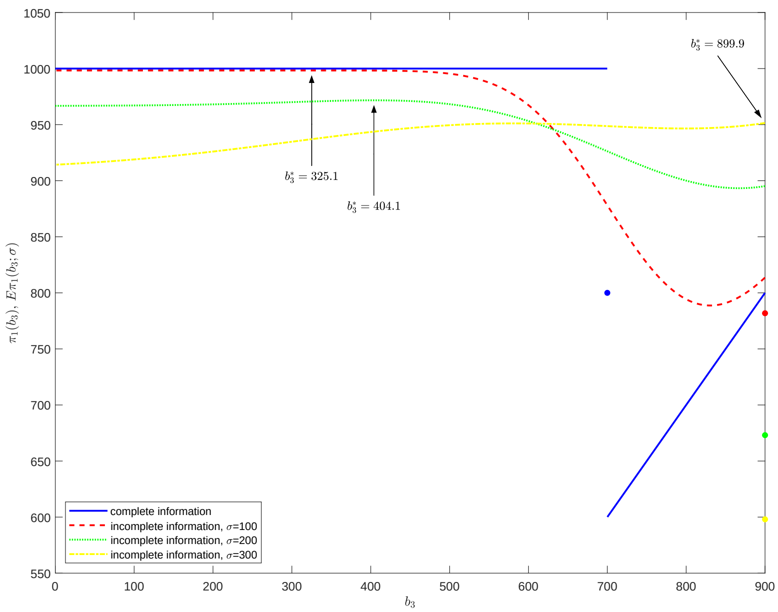
For comparison, in the game of complete information the profit of firm 1 in equation (S2) in Online Appendix A.3 becomes

$$
\pi_1(b_1, 700, b_3) = \begin{cases} 1000 & \text{if} \quad b_3 < 700, \\ b_3 - 100 & \text{if} \quad b_3 > 700, \\ 800 & \text{if} \quad b_3 = 700, \end{cases} \tag{S8}
$$

where we assume that firm 2 truthfully bids $b_2 = 700$ and firm 1 bids $b_1 < b_3$ as in the game of incomplete information. Note that in the game of complete information the profit of firm 1 again depends solely on b_3 and that firm 1 always bids $b_3 \in [0, 700)$.

Figure S2 is analogous to Figure S1. As $\sigma \to 0^+$, the expected profit of firm 1 under incomplete information again closely resembles the profit of firm 1 under complete information. Figure S2 further shows that $b_3(100, 300, \sigma)$ in the game of incomplete information gets close to the reservation value $v_3 = 300$ of TV station 3 as $\sigma \to 0+$. In this example, a small amount of incomplete information thus appears to single out truthful bidding. Finally, Figure S2 shows that $b_3(100, 300, \sigma)$

Figure S2: Expected profit and profit of firm 1 in equations (S7) and (S8) with $v_2 = 700$



gets close to 900 as $\sigma \to \infty$. A large amount of incomplete information thus appears to support close to extreme overbidding even though firm 1 never bids $b_3 = 900$ in the game of complete information as we show in Online Appendix A.3.

C Private equity firms' acquisitions and sales of TV stations

Figures S3-S5 document the timeline of acquisitions (black) and sales (red) of TV stations by LocusPoint, NRJ, and OTA. As stated in the main text, from 2010 to 2015 these private equity firms acquired 48 UHF stations. In addition, as stated in footnote 46, LocusPoint acquired W33BY-D (facility ID 25722), WMJF-CD (facility ID 191262), and WBNF-CD (facility ID 14326) and sold them to HME Equity Fund II LLC before the reverse auction; we exclude these UHF stations from Figure S3. NRJ acquired KFWD (facility ID 29015); we include this VHF station in Figure S4. Finally, LocusPoint acquired WPHA-CD (facility ID 72278) from D.T.V. LLC in a deal that apparently has not been consummated due to a law suit between the two parties; we exclude this UHF station from Figure S3.[S3]

We obtain the holdings of LocusPoint, NRJ, and OTA as of 2015 from BIA. We rely on news coverage to confirm these holdings and identify any changes to them.[S4] We have been unable to

[S3]See https://publicfiles.fcc.gov/api/service/tv/application/1709537.html and Paragraph 81 of https://transition.fcc.gov/eb/Orders/2016/FCC-16-41A1.html, accessed on April 1, 2018.

[S4]We primarily track TV station trading news through http://www.tvnewscheck.com/ and https://www.rbr.

ascertain the purchase price for W24BB-D (facility ID 68137) and thus set it to zero. If multiple TV stations were acquired in a single transaction, then we allocate the total purchase price to each acquired TV station in proportion to its interference free population.

The FCC released the identity of the TV stations that relinquished their licenses in the reverse auction along with their payouts. OTA voluntarily surrendered the license of WJPW-CD (facility ID 68407) to the FCC.[S5] We exclude from Table 5 and Figures S3-S5 any sales of non-spectrum assets such as programming contracts, or equipment.[S6] We set the sales price of non-spectrum assets to zero if we cannot ascertain it separately in a transaction involving multiple TV stations.

D Pseudo code for algorithm

There are N TV stations in the focal DMA and its neighbors. Throughout we fix the vector $b = (b_1, \ldots, b_N)$ of their bids. Using the notation in Section 3, PO_j is the payout of TV station j from the reverse auction and π_j its profit. The base clock price is P, the set of active TV stations is A, the set of inactive TV stations is I, and the set of frozen TV stations is F, where we omit the dependence of these objects on the round τ of the reverse auction.

Full repacking. Algorithm 1 describes the algorithm that we use under full repacking as well as under naive bidding with $b = (s_1, \ldots, s_N)$. On line 1, $|Y| \leq 1$ by assumption, except possibly if $\tau = 1$, so that at most one active TV station opts to remain on the air.

Limited repacking. Algorithm 2 describes the algorithm that we use under limited repacking. It takes the output of the algorithm under full repacking and naive bidding as an input.

We relabel TV stations such that TV stations $\{1, \ldots, K\}$ are in the focal DMA and TV stations $\{K+1, \ldots, N\}$ are in the neighboring DMAs. We denote by $F^{*,full,naive}$ the (appropriately relabeled) set of frozen TV stations at the conclusion of the reverse auction from the algorithm under full repacking and naive bidding. In the initialization, $F^{*,full,naive} \cap \{K+1, \ldots, N\}$ is the set of TV stations in neighboring DMAs that have been frozen under full repacking and naive bidding; these TV stations cannot freeze another TV stations under limited repacking. On line 3, $A \cap \{1, \ldots, K\}$

com/.

[S5] See https://enterpriseefiling.fcc.gov/dataentry/public/tv/draftCopy.html?displayType=html&appKey=25076ff35f490dae015f4fa9968c0e0d&id=25076ff35f490dae015f4fa9968c0e0d&goBack=N, accessed on April 30, 2018.

[S6] NRJ sold the non-spectrum assets of WGCB-TV (facility ID 55350), WMFP (facility ID 41436), and WTVE (facility ID 55305) after relinquishing their licenses in the reverse auction and OTA sold the non-spectrum assets of KTLN-TV (facility ID 49153), WEBR-CD (facility ID 67866), WYCN-CD (facility ID 9766), and WLWC (facility ID 3978), see http://www.tvnewscheck.com/article/108526/station-trading-roundup-5-deals-259m, accessed on April 1, 2018, https://tvnewscheck.com/article/242153/station-trading-roundup-1-deal-81-2m/, accessed on July 14, 2020, https://tvnewscheck.com/article/108888/station-trading-roundup-1-deal-12500/, accessed on July 14, 2020, https://tvnewscheck.com/article/108526/station-trading-roundup-5-deals-25-9m/, accessed on July 14, 2020, and https://tvnewscheck.com/article/106271/nexstar-buys-zombie-station-wlwc-for-4-1m/, accessed on July 14, 2020,

Figure S3: Timeline of LocusPoint's acquisitions (black) and sales (red) of TV stations

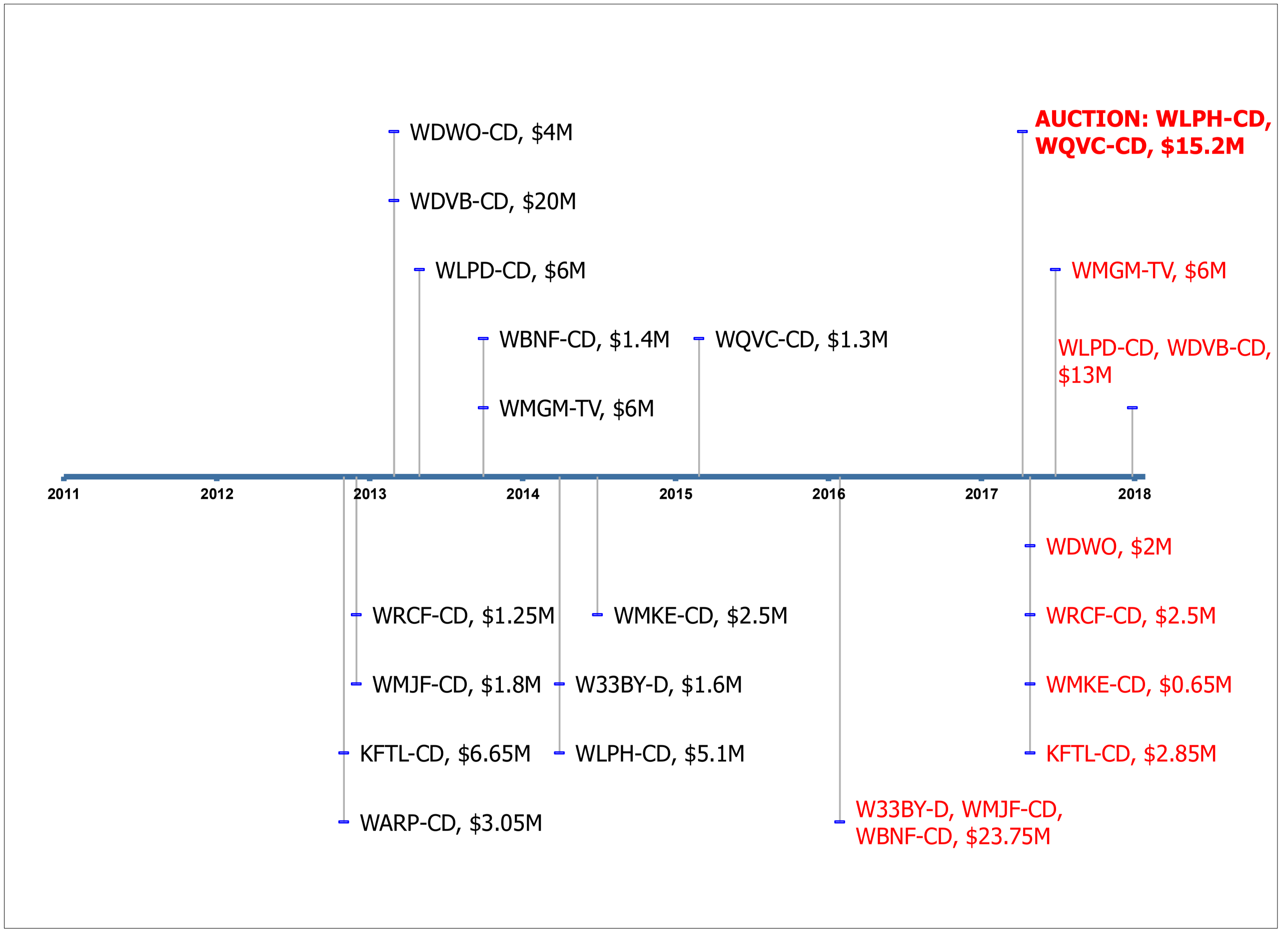


Figure S4: Timeline of NRJ's acquisitions (black) and sales (red) of TV stations

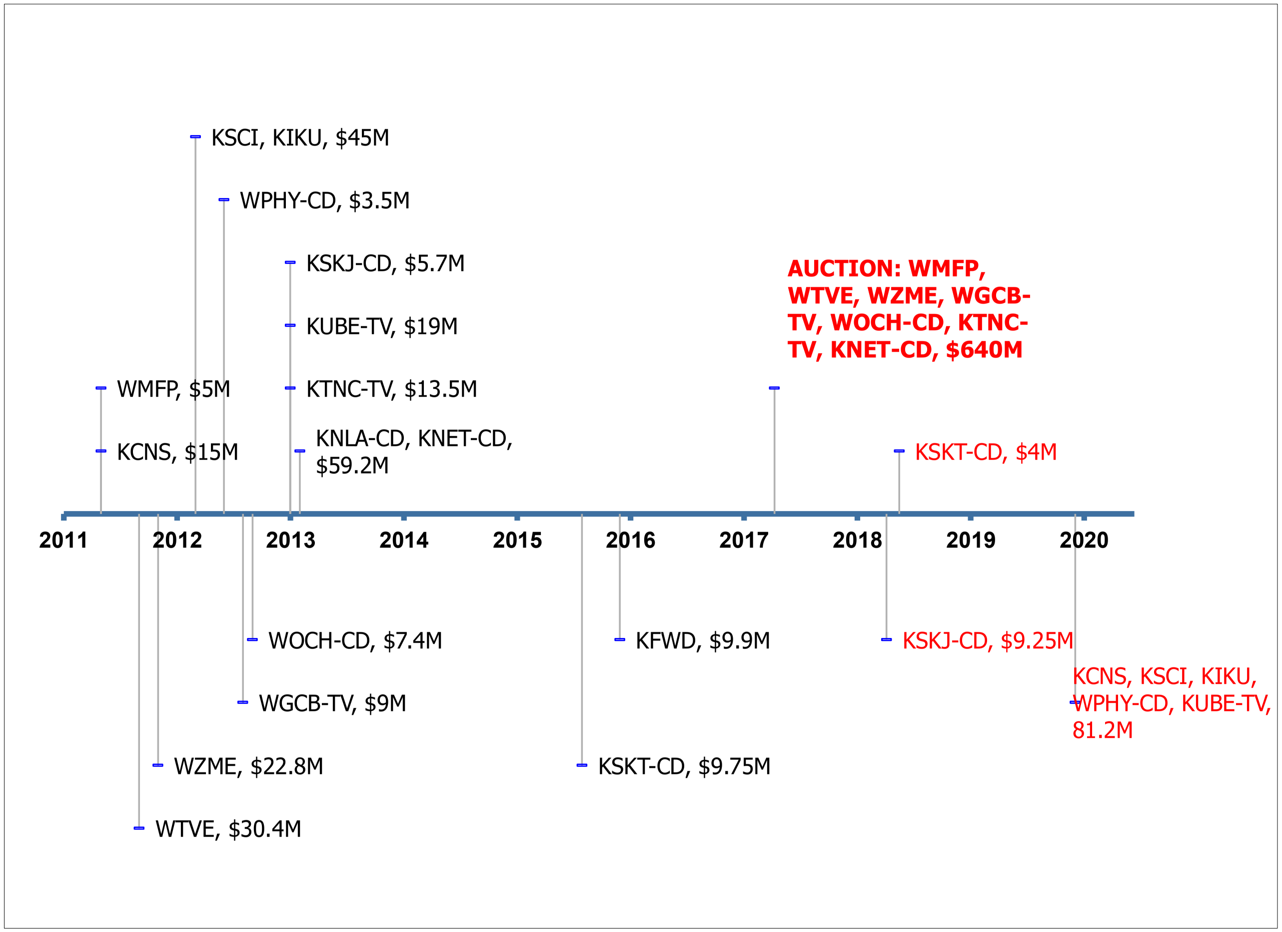
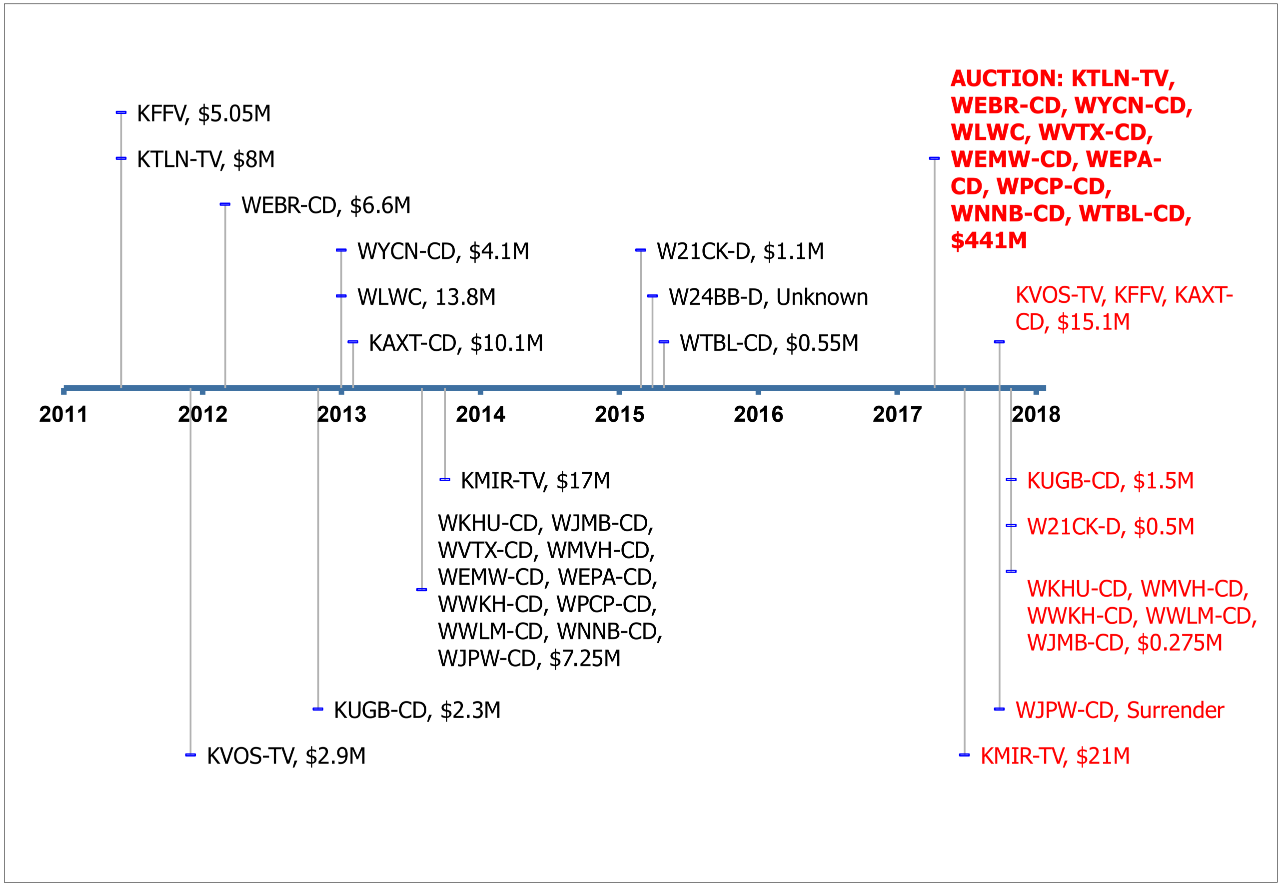


Figure S5: Timeline of OTA's acquisitions (black) and sales (red) of TV stations



Algorithm 1 Full repacking

Initialization: Set $\tau = 1$, $P = 900$, $A = \{1, \ldots, N\}$, $I = \emptyset$, and $F = \emptyset$.
Repeat

1. Let $Y = \{k \in A | b_k \geq P\}$ be the set of active TV stations that opt to remain on the air at a base clock price of P. Set $A \leftarrow A \setminus Y$, $I \leftarrow I \cup Y$, and $PO_j = \pi_j = 0$ for all $j \in Y$.
2. If $\tau = 1$ and $S(Y, R) \neq 1$, then these TV stations cannot be repacked and the reverse auction has failed at the outset (see footnote 28). Set a flag, $PO_j = \pi_j = 0$ for all $j \in A$, and terminate.
3. For all $k \in A$ do
   (a) If $S(I \cup \{k\}, R) \neq 1$, then active TV station k cannot additionally be repacked. In this case, set $A \leftarrow A \setminus \{k\}$, $F \leftarrow F \cup \{k\}$, $PO_k = \varphi_k P$, and $\pi_k = \varphi_k P - v_k$.
4. End
5. If $A \neq \emptyset$, then set $P = \max_{j \in A} b_j$, $\tau \leftarrow \tau + 1$, and continue with the decreased based clock price.
6. If $P = 0$, then the reverse auction concludes with a base clock price of 0 (see footnote 29). Set a flag, $F \leftarrow F \cup A$, $PO_j = 0$ and $\pi_j = -v_j$ for all $j \in A$, and $A = \emptyset$ (in this order).

Until $A = \emptyset$.

is the set of active TV stations in the focal DMA; these are the only TV stations that can be frozen under limited repacking.

E Robustness to underbidding

We investigate the impact of underbidding on payouts for the New York, NY, DMA under the 84 MHz clearing target. Allowing the owner of a jointly owned TV station j located inside the focal DMA to underbid $b_j = 0$ in addition to bid truthfully $b_j = s_j$ and overbid $b_j = 900$ increases the number strategy profiles from 189 to 8,575. To lighten the computational burden, we reduce to number of simulation draws from $N^S = 100$ to $N^S = 50$.

As Table S31 shows, allowing for underbidding has a small impact on payouts. Although allowing for underbidding enlarges the set of payout-unique equilibria, the overlap with the set of payout-unique equilibria in the base case that rules out underbidding is large. In the base case, we find 2,532 equilibria across simulation draws that map into 138 payout-unique equilibria. With underbidding, across the same draws, we find 13,234 equilibria that map into 200 payout-unique equilibria. Yet, 120 payout-unique equilibria appear in both the base case and with underbidding.

Algorithm 2 Limited repacking

Initialization: Set $\tau = 1$, $P = 900$, $A = \{1, \ldots, N\} \setminus \left(F^{*,full,naive} \cap \{K+1, \ldots, N\}\right)$, $I = \emptyset$, and $F = F^{*,full,naive} \cap \{K+1, \ldots, N\}$.

Repeat

1. Let $Y = \{k \in A | b_k \geq P\}$ be the set of active TV stations that opt to remain on the air at a base clock price of P. Set $A \leftarrow A \setminus Y$, $I \leftarrow I \cup Y$, and $PO_j = \pi_j = 0$ for all $j \in Y$.

2. If $\tau = 1$ and $S(Y, R) \neq 1$, then these TV stations cannot be repacked and the reverse auction has failed at the outset (see footnote 28). Set a flag, $PO_j = \pi_j = 0$ for all $j \in A$, and terminate.

3. For all $k \in A \cap \{1, \ldots, K\}$ do

   (a) If $S(I \cup \{k\}, R) \neq 1$, then active TV station k cannot additionally be repacked. In this case, set $A \leftarrow A \setminus \{k\}$, $F \leftarrow F \cup \{k\}$, $PO_k = \varphi_k P$, and $\pi_k = \varphi_k P - v_k$.

4. End

5. If $A \neq \emptyset$, then set $P = \max_{j \in A} b_j$, $\tau \leftarrow \tau + 1$, and continue with the decreased base clock price.

6. If $P = 0$, then the reverse auction concludes with a base clock price of 0 (see footnote 29). Set a flag, $F \leftarrow F \cup A$, $PO_j = 0$ and $\pi_j = -v_j$ for all $j \in A$, and $A = \emptyset$ (in this order).

Until $A = \emptyset$.

Table S31: Payouts to TV stations in New York, NY, DMA with underbidding

Payouts ($ billion)	Naive bidding	Strategic bidding: Mean	Min	Median	Max	Payout increase at mean (%)
Panel A: 84 MHz clearing target						
Base case	0.375	0.410	0.398	0.409	0.423	9.5
	(0.103)	(0.109)	(0.109)	(0.108)	(0.112)	
With underbidding	0.375	0.411	0.395	0.411	0.425	9.6
	(0.103)	(0.112)	(0.113)	(0.112)	(0.112)	

Notes: Payout increase at mean calculated as percent difference between mean payouts under strategic and naive bidding. Using $N^S = 50$ simulation draws.

F Advertising revenue imputation

Table S32 reports parameter estimates for imputing missing advertising revenue, as described in Appendix A.4.

Table S32: Advertising revenue imputation by year

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2015
ln($InterferenceFreePop_{jt}$)	0.481***	0.470***	0.406***	0.365***	0.333***	0.294***	0.304***	0.302***	0.307***	0.264***	0.268***	0.225***
	(0.048)	(0.047)	(0.044)	(0.043)	(0.042)	(0.040)	(0.040)	(0.038)	(0.038)	(0.035)	(0.035)	(0.038)
Multicast	0.214***	0.195***	0.203***	0.134**	0.150***	0.146***	0.150***	0.090*	0.112**	0.081	0.075	0.143**
	(0.052)	(0.049)	(0.051)	(0.053)	(0.053)	(0.052)	(0.052)	(0.051)	(0.052)	(0.050)	(0.050)	(0.061)
Low-power LPTV	-0.020	-0.277**	-0.241*	-0.304**	-0.310**	-0.316***	-0.268**	-0.120	-0.182	-0.132	-0.157	-0.164
	(0.146)	(0.138)	(0.134)	(0.130)	(0.121)	(0.116)	(0.114)	(0.108)	(0.110)	(0.105)	(0.104)	(0.105)
Full-power	0.735***	0.620***	0.753***	0.846***	0.864***	0.860***	0.888***	0.969***	0.909***	0.969***	0.952***	1.022***
	(0.115)	(0.114)	(0.110)	(0.111)	(0.104)	(0.100)	(0.101)	(0.095)	(0.096)	(0.093)	(0.092)	(0.094)
Owns >1 station in DMA	0.029	0.019	0.056	0.070	0.092*	0.106**	0.109**	0.081	0.107**	0.102**	0.116**	0.124**
	(0.056)	(0.055)	(0.055)	(0.054)	(0.054)	(0.052)	(0.052)	(0.051)	(0.052)	(0.050)	(0.050)	(0.052)
Owns 2-10 stations across DMAs	0.108	0.093	0.087	0.047	0.082	-0.005	0.111	0.090	0.180**	0.173**	0.165**	0.195**
	(0.080)	(0.079)	(0.082)	(0.084)	(0.084)	(0.081)	(0.085)	(0.083)	(0.083)	(0.083)	(0.084)	(0.093)
Owns >10 stations across DMAs	0.342***	0.304***	0.251***	0.247***	0.208**	0.181**	0.225***	0.240***	0.353***	0.277***	0.275***	0.342***
	(0.079)	(0.078)	(0.081)	(0.085)	(0.085)	(0.081)	(0.084)	(0.082)	(0.082)	(0.082)	(0.081)	(0.087)
# Stations in DMA	0.002	0.005	0.006	0.005	0.003	0.002	0.007	0.011**	0.012**	0.019***	0.010	0.005
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)
# Major network affiliates in DMA	-0.046	-0.032	-0.018	0.003	-0.003	-0.003	0.030	0.064	0.076*	0.146***	0.074	-0.004
	(0.032)	(0.032)	(0.032)	(0.033)	(0.033)	(0.034)	(0.038)	(0.040)	(0.041)	(0.045)	(0.047)	(0.034)
$WealthIndex_{jt}$	0.125***	0.120***	0.133***	0.123***	0.123***	0.133***	0.133***	0.148***	0.150***	0.157***	0.147***	0.149***
	(0.024)	(0.023)	(0.024)	(0.024)	(0.024)	(0.023)	(0.024)	(0.023)	(0.023)	(0.022)	(0.023)	(0.025)
$CompIndex_{jt}$	0.026	-0.017	-0.053	-0.092	-0.060	-0.048	-0.152	-0.252**	-0.275**	-0.462***	-0.245*	-0.075
	(0.081)	(0.084)	(0.088)	(0.091)	(0.090)	(0.093)	(0.105)	(0.115)	(0.121)	(0.130)	(0.134)	(0.086)
ln($DMAPop_{jt}$)	0.361***	0.385***	0.409***	0.469***	0.502***	0.507***	0.500***	0.509***	0.493***	0.529***	0.528***	0.507***
	(0.053)	(0.052)	(0.051)	(0.051)	(0.049)	(0.048)	(0.047)	(0.045)	(0.045)	(0.043)	(0.043)	(0.046)
Network affiliation fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Affiliation groups × U.S. states	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Adjusted R^2	0.994	0.994	0.993	0.993	0.992	0.993	0.992	0.993	0.992	0.992	0.992	0.991
N	1191	1215	1247	1307	1343	1364	1371	1379	1397	1415	1421	1454