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1. Introduction

Auction participants often find subtle ways to communicate with their rivals. A well-known example is "code bidding" in the FCC spectrum auctions, where bidders used trailing digits in their bids to signal which licenses competitors should avoid (Cramton and Schwartz, 2000). Communication can also deter entry more directly. In the FCC PCS auction, Pacific Bell reportedly discouraged competitors from bidding for the Los Angeles license by publicly announcing a "commitment to win" (Milgrom, 2004) and by making clear that, as the incumbent, it could respond to entry by outbidding challengers only as much as necessary (Klemperer, 1998; Binmore and Klemperer, 2002). These examples suggest a broader point: when participation is costly, information communicated by an incumbent may reduce competition by making entry unattractive.

This paper studies a simple version of this idea. We consider a second-price auction with one incumbent bidder and one potential entrant. The incumbent observes her value before the entrant decides whether to pay a cost to enter and learn his own value.[1] Before values are realized, the incumbent commits to a binary disclosure rule that reports whether her value is above or below a threshold. We show that the incumbent optimally chooses an informative threshold: after a low report, the entrant participates; after a high report, he stays out. As a result, disclosure lowers expected seller revenue relative to the no-communication benchmark.

Our paper contributes to the literature on information disclosure in auctions. In their seminal paper, Milgrom and Weber (1982b) established the linkage principle: in affiliated-values auctions, seller disclosure can raise expected revenue by linking bidders' payments more closely to information about the value of the object. Subsequent work shows that this revenue-enhancing role of disclosure is not universal. Ganuza (2004) studies a private-value environment with endogenous valuations and shows that a revenue-maximizing seller may disclose less information than is efficient, since ignorance can intensify competition. Board (2009) isolates an allocation effect

[1] We are therefore assuming that one bidder is more informed than the other in the same spirit as Milgrom and Weber (1982a) and Engelbrecht-Wiggans et al. (1983)

through which information revelation may reduce revenue when it changes the ranking of bidders' valuations. Closest to our paper, Bergemann et al. (2022) characterize optimal seller disclosure in classic auctions. In their model, the seller controls what bidders learn about their own values and optimally pools high values to reduce information rents. We instead study disclosure controlled by a bidder rather than by the seller. In our setting, the incumbent discloses information about her own value before a rival's entry decision, and high-value disclosure reduces seller revenue by deterring entry.

2. Environment

There are two buyers indexed by $i \in \{S, R\}$. They are vying for one unit of an indivisible good. S is an incumbent and R is a potential entrant. Their values for the good, v_S and v_R, are independently drawn from a common distribution function, F, supported on $[0, 1]$. We further assume that F has a density, f, which is continuous and positive on $[0, 1]$. Buyers are risk neutral expected utility maximizers with quasilinear preferences. Thus if i receives the good with probability x_i in exchange for a payment p_i, their auction-stage utility is $v_i x_i - p_i$.

The timing is as follows:

1. Before she learns her value, buyer S publicly commits to a disclosure rule $\sigma : [0, 1] \to \Delta(\{\ell, h\})$ which maps her value into a conditional distribution over messages. We restrict our attention to threshold disclosure rules:

$$\sigma(\ell|v_S) = \mathbf{1}\{v_S \leq t\} \quad \text{and} \quad \sigma(h|v_S) = \mathbf{1}\{v_S > t\}. \tag{1}$$

2. Values realize. S observes her value, v_S, whereas R can only observe the message m drawn from $\sigma(\cdot|v_S)$. R must then decide whether to enter the auction.

   (a) If R enters the auction at a cost $c > 0$, then he learns his value v_R and competes for the good with S in a second-price auction with no reserve price.

(b) If R stays out of the auction, then S receives the good for free.

Our solution concept is weak perfect Bayesian equilibrium. We impose truthful bidding in the auction stage and select S-preferred equilibria: whenever R is indifferent between entering and staying out, he stays out. We refer to such an assessment simply as an equilibrium.

Our question is simple: Does there exist an equilibrium in which S chooses an informative threshold, i.e., $t \in (0,1)$ as opposed to $t \in \{0,1\}$?

3. Main Result

We begin by ruling out the uninteresting case in which R has no incentive to enter in the absence of communication. Let

$$\Pi(F) := \int_0^1 \int_0^v (v-s)\ \mathrm{d}F(s)\ \mathrm{d}F(v) \tag{2}$$

denote R's prior gross expected surplus. We assume that $c < \Pi(F)$.

Proposition 1. *Suppose $c < \Pi(F)$. There exists an equilibrium in which S chooses an informative threshold $t^* \in (0,1)$. In this equilibrium, R enters after the low message and stays out after the high message. Moreover, expected seller revenue is strictly lower than in the no-communication benchmark.*

The intuition behind our result is as follows: The threshold t has two opposing effects. A lower threshold makes the high message more likely, but also less discouraging: conditional on h, R only learns that S's value exceeds a low cutoff. A higher threshold makes the high message more discouraging, but also less likely. Since S benefits from deterring entry whenever her value is positive, she wants the high region to be as large as possible subject to making entry unattractive after h. The optimal threshold is therefore the smallest threshold at which the high message deters entry. Entry still occurs after the low message, so disclosure reduces seller revenue by suppressing competition precisely when the incumbent's value is high.

Proof. Fix $t \in (0,1)$. When S's threshold is t and R observes message $m \in \{\ell, h\}$, his posterior distribution F_t^m about v_S is given by

$$F_t^\ell(s) = \begin{cases} \frac{F(s)}{F(t)} & \text{if } s \leq t; \\ 1 & \text{if } s > t, \end{cases} \quad F_t^h(s) = \begin{cases} 0 & \text{if } s \leq t; \\ \frac{F(s)-F(t)}{1-F(t)} & \text{if } s > t. \end{cases} \tag{3}$$

Thus if R's posterior distribution is $G \in \{F_t^\ell, F_t^h\}$, his gross expected surplus from entering is

$$\begin{aligned} \Pi(G) &:= \int_0^1 \int_0^v (v-s)\ \mathrm{d}G(s)\ \mathrm{d}F(v) && (4) \\ &= \int_0^1 \int_0^v G(s)\ \mathrm{d}s\ \mathrm{d}F(v) && (5) \\ &= \int_0^1 G(s) \int_s^1\ \mathrm{d}F(v)\ \mathrm{d}s && (6) \\ &= \int_0^1 (1-F(s))G(s)\ \mathrm{d}s. && (7) \end{aligned}$$

The condition for R to enter after message m is $\Pi(F_t^m) > c$.

We now show that only message h can deter entry. Because $F_t^h \leq F_t^\ell$, we have $\Pi(F_t^h) \leq \Pi(F_t^\ell)$. Moreover,

$$F(t)F_t^\ell + (1-F(t))F_t^h = F. \tag{8}$$

Because Π is linear,

$$\begin{aligned} F(t)\Pi(F_t^\ell) + (1-F(t))\Pi(F_t^h) &= \Pi(F) && (9) \\ &> c. && (10) \end{aligned}$$

Therefore $\Pi(F_t^\ell) > c$, so R always enters after ℓ; if disclosure is to deter entry, it must do so after h.

Define R's gross surplus after entering upon seeing an h message (and before learning his value) as

$$\Phi(t) \coloneqq \Pi(F_t^h) = \int_t^1 (1 - F(s)) \frac{F(s) - F(t)}{1 - F(t)} \, \mathrm{d}s. \tag{11}$$

Observe that

$$\Phi'(t) = -\frac{f(t)}{(1 - F(t))^2} \int_t^1 (1 - F(s))^2 \, \mathrm{d}s < 0, \tag{12}$$

and hence Φ is strictly decreasing on $(0, 1)$. Moreover, $\lim_{t \to 0} \Phi(t) = \Pi(F) > c > \lim_{t \to 1} \Phi(t) = 0$. Since Φ is continuous on $(0, 1)$, the intermediate value theorem implies that there is a unique $t^* \in (0, 1)$ with $\Phi(t^*) = c$.

We now show that S optimally chooses t^* as her threshold. If R enters and S's value is s, her expected payoff in the auction is

$$A(s) \coloneqq \int_0^s (s - r) \, \mathrm{d}F(r). \tag{13}$$

If R stays out, S receives the good for free, so her payoff in that case is s. Since $s > A(s)$ for every $s > 0$, we deduce that S strictly prefers to deter entry whenever her value is positive.

If $t < t^*$, then R enters after both messages (since $\Phi(t) > c$), so S's ex ante payoff in this case is

$$U^E \coloneqq \int_0^1 A(s) \, \mathrm{d}F(s). \tag{14}$$

If $t \geq t^*$, then R enters after ℓ and stays out after h (since $\Phi(t) \leq c$), in which case S's ex ante payoff is

$$U(t) \coloneqq \int_0^t A(s) \, \mathrm{d}F(s) + \int_t^1 s \, \mathrm{d}F(s). \tag{15}$$

For $t^* \leq t_1 < t_2 \leq 1$, we have

$$U(t_1) - U(t_2) = \int_{t_1}^{t_2} (s - A(s)) \, \mathrm{d}F(s) > 0. \tag{16}$$

Thus conditional on deterring entry, S wants to choose the smallest possible threshold which does so. Since the deterrence constraint is $\Phi(t) \leq c$, that threshold is the unique value of t satisfying $\Phi(t) = c$, namely, $t = t^*$. Lastly,

$$U(t^*) - U^E = \int_{t^*}^{1} (s - A(s))\ \mathrm{d}F(s) > 0, \tag{17}$$

so t^* strictly dominates every threshold that fails to deter entry. Since truthful bidding is weakly dominant in the second-price auction, the assessment we have constructed does constitute an S-preferred equilibrium. In the assessment, S chooses t^* as her threshold; after message m, R enters if $\Pi(F_t^m) > c$, with ties broken in favor of S by staying out when $\Pi(F_t^m) = c$; and conditional on there being entry, both bidders bid truthfully.

Lastly, it remains to verify that expected revenue is strictly lower with communication. Under the threshold t^*, entry occurs only after the low message, $m = \ell$. Thus expected seller revenue is

$$\begin{aligned} R(t^*) &\coloneqq \int_0^{t^*} \mathbf{E}[\min\{v_R, s\}]\ \mathrm{d}F(s) && (18)\\ &= \int_0^{t^*} \int_0^{s} (1 - F(r))\ \mathrm{d}r\ \mathrm{d}F(s) && (19)\\ &= \int_0^{t^*} (1 - F(r))(F(t^*) - F(r))\ \mathrm{d}r, && (20) \end{aligned}$$

whereas in the absence of communication, expected seller revenue is given by

$$\begin{aligned} R^E &\coloneqq \mathbf{E}[\min\{v_S, v_R\}] && (21)\\ &= \int_0^{1} (1 - F(r))^2\ \mathrm{d}r. && (22) \end{aligned}$$

Since $t^* < 1$, for every $r \in [0, t^*]$, we have

$$F(t^*) - F(r) < 1 - F(r), \tag{23}$$

and hence $R(t^*) < R^E$, as desired. □

4. Conclusion

We have shown that an incumbent bidder may benefit from disclosing private information before a potential rival decides whether to enter. In a second-price auction with costly entry, the incumbent can commit to a simple threshold disclosure rule that reveals whether her value is high or low. In equilibrium, she chooses an informative threshold: after a low report, the entrant participates; after a high report, he stays out.

The mechanism is straightforward. Because truthful bidding is weakly dominant in a second-price auction, disclosure does not weaken the incumbent at the bidding stage. Instead, it affects the entrant's participation constraint. A high report makes competition appear sufficiently tough that entry is no longer profitable. Thus, when participation is costly, even coarse disclosure can serve an entry-deterrence role.

The analysis suggests a broader point. Transparency by bidders need not facilitate competition or raise seller revenue (as is the case in the affiliated-values model of Milgrom and Weber (1982b)). When information is controlled by an informed incumbent, disclosure may instead reduce competition by discouraging rivals from entering.

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Appendix

In this appendix, we show that the choice of threshold rules is without loss of generality. It is clear that information structures with two messages are without loss of generality, since bidding behavior conditional on entry is unaffected by the observed message.

Let $M = \{\ell, h\}$ and let $\sigma : [0,1] \to \Delta M$ be an arbitrary[2] information structure. If σ fails to deter entry after both messages, then it is equivalent to a threshold information structure with a threshold of $t \in \{0,1\}$. So let us assume that entry is deterred after $m = h$. Note that entry cannot be deterred by $m = \ell$ by the same argument as before.

Next, note that if σ is *not* of the threshold variety, then

$$\forall t \in [0,1], \big[\exists s < t, \sigma(h|s) \neq 0 \text{ or } \exists s > t, \sigma(h|s) \neq 1\big]. \tag{24}$$

[2]By arbitrary we mean arbitrary within the class of regular conditional probability measures.

If $\exists t \in [0,1]$ such that the probability of $\{s < t, \sigma(h|s) \neq 0\} \cup \{s > t, \sigma(h|s) \neq 1\}$ vanishes, then σ is clearly equivalent to a threshold rule. So we need only look at one of two types of rules:[3]

1. One where $\exists V_0 \in \mathcal{B}[0,1], \int_{V_0} \mathrm{d}F > 0$ and $\forall s \in V_0, 0 < \sigma(h|s) < 1$;
2. And one where $\exists V_0 \in \mathcal{B}[0,1], \int_{V_0} \mathrm{d}F > 0$ and $\exists t_0 \in [0,1]$ such that for $s \in V_0 \cap [0,t), \sigma(h|s) = 1$ and $s \in V_0 \cap (t,1], \sigma(h|s) = 0$.

1 Threshold Disclosure Rules Are Without Loss

In this appendix, we show that restricting attention to threshold disclosure rules is without loss of generality for the incumbent's optimization problem.

Consider an arbitrary disclosure rule and the entrant's associated equilibrium entry decisions. Because the entrant takes only two possible actions, all messages that induce entry can be merged into a single message ℓ, and all messages that deter entry can be merged into a single message h.

Indeed, the entrant's expected surplus after a merged message is a weighted average of his expected surpluses after the original messages. Thus, the merger of messages that induce entry still induces entry, while the merger of messages that deter entry still deters entry. It is therefore enough to consider binary disclosure rules.

Let

$$p(s) := \sigma(h \mid s) \tag{25}$$

denote the probability that the incumbent sends the entry-deterring message when her value is s. Let

$$q := \int_0^1 p(s)\, dF(s) \tag{26}$$

denote the ex ante probability of message h.

$p(s)/q = \frac{pr(s|h)}{pr(s)}$

[3] There are rules that are combinations of both, too.

Suppose that h deters entry with positive probability. Then $q \in (0, 1)$. To see this, note that $q > 0$ by assumption. Moreover, $q < 1$, because if $q = 1$, the entrant's posterior after h would equal the prior, under which entry is profitable by the assumption $c < \Pi(F)$.

If the incumbent's value is s, the entrant's gross expected surplus from entering is

$$B(s) := \int_s^1 (v - s)\, dF(v). \tag{27}$$

The function B is strictly decreasing. The entrant's gross expected surplus after observing h is therefore

$$\Pi_h(p) = \frac{1}{q} \int_0^1 p(s) B(s)\, dF(s). \tag{28}$$

Because h deters entry,

$$\Pi_h(p) \le c. \tag{29}$$

Since F is continuous and strictly increasing, there exists a unique $t \in (0, 1)$ such that

$$1 - F(t) = q. \tag{30}$$

Consider the upper-tail threshold rule

$$p^*(s) := \mathbf{1}\{s > t\}. \tag{31}$$

This rule sends message h with the same ex ante probability as the original rule:

$$\int_0^1 p^*(s)\, dF(s) = 1 - F(t) = q = \int_0^1 p(s)\, dF(s). \tag{32}$$

Hence

$$\int_0^1 \big(p^*(s) - p(s)\big)\, dF(s) = 0. \tag{33}$$

For $s \le t$, we have

$$p^*(s) - p(s) \le 0 \qquad \text{and} \qquad B(s) \ge B(t). \tag{34}$$

For $s > t$, we have

$$p^*(s) - p(s) \geq 0 \qquad \text{and} \qquad B(s) \leq B(t). \tag{35}$$

It follows that

$$\begin{aligned} \int_0^1 \big(p^*(s) - p(s)\big) B(s)\, dF(s) &\leq B(t) \int_0^1 \big(p^*(s) - p(s)\big)\, dF(s) \\ &= 0. \end{aligned} \tag{36}$$

Therefore,

$$\Pi_h(p^*) = \frac{1}{q} \int_0^1 p^*(s) B(s)\, dF(s) \leq \frac{1}{q} \int_0^1 p(s) B(s)\, dF(s) = \Pi_h(p) \leq c. \tag{37}$$

Thus, whenever the original disclosure rule deters entry after h, the upper-tail threshold rule also deters entry after h.

It remains to compare the incumbent's payoffs. If the entrant participates and the incumbent's value is s, her expected auction payoff is

$$A(s) := \int_0^s (s - r)\, dF(r). \tag{38}$$

If entry is deterred, her payoff is s. Her gain from deterring entry is therefore

$$D(s) := s - A(s). \tag{39}$$

Because

$$A'(s) = F(s), \tag{40}$$

we have

$$D'(s) = 1 - F(s) > 0 \tag{41}$$

for every $s \in [0, 1)$. Thus, D is strictly increasing.

The incumbent's ex ante payoff under the disclosure rule p is

$$U(p) = \int_0^1 A(s)\, dF(s) + \int_0^1 p(s) D(s)\, dF(s). \tag{42}$$

For $s \leq t$, we have

$$p^*(s) - p(s) \leq 0 \qquad \text{and} \qquad D(s) \leq D(t), \tag{43}$$

while for $s > t$,

$$p^*(s) - p(s) \geq 0 \qquad \text{and} \qquad D(s) \geq D(t). \tag{44}$$

Consequently,

$$\begin{aligned} \int_0^1 \big(p^*(s) - p(s)\big) D(s)\, dF(s) &\geq D(t) \int_0^1 \big(p^*(s) - p(s)\big)\, dF(s) \\ &= 0. \end{aligned} \tag{45}$$

It follows that

$$U(p^*) \geq U(p). \tag{46}$$

Therefore, every binary disclosure rule that deters entry is weakly dominated, from the incumbent's perspective, by an upper-tail threshold rule that sends the entry-deterring message with the same ex ante probability. If the original rule differs from the threshold rule on a set of positive F-measure, the payoff inequality is strict.

Hence, restricting attention to threshold disclosure rules is without loss of generality. "'