Self-Enforcing Voluntary Disclosures (Gigler '94)

Aneesh Raghunandan

February 9, 2015

Background

- Previous literature suggests firms withhold private information in order to avoid proprietary costs (Verrecchia '83, Dye '85, etc.). Is this always the case?
- This paper shows that proprietary costs can actually increase voluntary disclosure, when such disclosure generates credibility.
- Does so by introducing tension in the form of a second (entrant) firm; the incumbent firm wishes to mislead the entrant downward while simultaneously misleading the market upward.
- Model only has cheap-talk equilibria rather than exact disclosures, unlike most previous voluntary disclosure models.
  - Extends Newman and Sansing, one such paper that did use cheap-talk equilibria, by allowing shareholders to sell their shares and by making the proprietary cost dependent upon the firm's private information.

Motivation

- Previous voluntary-disclosure models assume that firms would truthfully disclose all private information in the absence of proprietary costs, i.e., that these costs are the friction preventing full (truthful) disclosure.
- By contrast, in this setting firms wish to mislead the capital market to believe that profitability is higher than it actually is; since there is no cost of disclosure, any disclosure made by the firm in the absence of other tensions is unlikely to be credible ("cheap talk").
- The friction leading to an equilibrium in this case is the second firm. Firms play a Cournot game in the final stage, and Firm 1 has the opportunity to mislead Firm 2 about the total market demand. As such, Firm 1 would like to send Firm 2 a negative signal about the market, so that Firm 2 underproduces.

Model Setup

- Two firms and the market
- Firms compete in a Cournot fashion, with market demand parameter t; i.e., the market demand function is given by

$$P = t - q_1 - q_2$$

- Firm 1 (the firm of interest) has a first-mover advantage in the sense that before firms make output decisions, it observes a private signal about t. After observing t, Firm 1 sends a signal $m(t)$, seen by both the market and the second firm.
- Cournot profits are $\pi_1 = q_1(t - q_1 - q_2)$ and $\pi_2 = q_2(t - q_1 - q_2)$.

Model Setup

- Capital market pays K to buy a share α of the firm. K is assumed to be fixed, so that α is a function of K and the firm's expected terminal value. That is,

$$\alpha \cdot \mathbb{E}[\pi_1(q_1, q_2, t)|m] = K$$

- Note that this doesn't affect the firm's output decision; by assumption that firm values its current owners and future shareholders equally, firm maximizes the following with respect to q_1:

$$(1-\alpha)\pi_1(m) + K = \pi_1(q_1, q_2(m), t)$$

- Other equilibrium conditions: firm 2 maximizes $\mathbb{E}[\pi_2(q_2, q_1(m, t), t)|m]$ and the market sets

$$\alpha(m) = \frac{K}{\mathbb{E}[\pi_1(q_1(m, t), q_2(m), t)|m]}$$

Key Assumption

At each period of time, firm only maximizes over *current* shareholders. So before selling equity, in stage 1 the firm maximizes $(1-\alpha)\mathbb{E}[\pi_1|m]$. This means that when making its reporting decision, the firm maximizes

$$(1-\alpha(m))\mathbb{E}[\pi_1|m]$$

for each t, given the following equilibrium beliefs by the other parties:

$$f(t|m) = \frac{f(t)}{\int_{T(m)} f(\tau)d\tau} \text{ for } m(t) = m$$

(and zero otherwise).

Second-Stage Equilibrium (Lemma 1)

- Given a disclosure strategy $m(t)$, the stage-2 equilibrium in product and capital markets is given by

$$
\begin{aligned}
q_2(m) &= \frac{\mathbb{E}[t|m]}{3} \\
q_1(m,t) &= \frac{t - q_2(m)}{2} = \frac{3t - \mathbb{E}[t|m]}{6} \\
\pi_1(q_1, q_2, t) &= \frac{(t - q_2(m))^2}{4} \\
\alpha(m) &= \frac{36K}{4(\mathbb{E}[t|m])^2 + 9\text{Var}[t|m]}
\end{aligned}
$$

Supporting Result: Proposition 1

- Proposition 1: there can be no information disclosed privately to either the competitor or the capital market in equilibrium.
- Sketch of proof: show that if private disclosure to market, firm has incentive to inflate as much as possible (disclosure is costless) so market ignores the disclosure and uses its prior for α; similarly, if privately disclosing to Firm 2, Firm 1 has incentive to deflate as much as possible and so Firm 2 also ignores any disclosure.

Supporting Results: Propositions 2 and 3

- These propositions also exist to set up the main result of the paper.
- Proposition 2: Any equilibrium strategy $m(t)$ results in a nondecreasing outcome; i.e., if $t'' > t$ then $(\alpha(t''), q_2(t'')) \geq (\alpha(t'), q_2(t'))$.
- Follows from Lemmas 2 (game is a cheap-talk game) and 3 (set of equilibrium outcomes are completely ordered). Useful for Proposition 4 (the main result).
- Proposition 3: There are no full disclosure intervals in a public disclosure equilibrium.

Main Result: Partition Equilibria (Proposition 4)

- Proposition 4: All public disclosure equilibria are partition equilibria. That is, equilibrium outcomes are characterized by

$$q_2(t) = \frac{\mathbb{E}[t|t \in (t_i, t_{i+1})]}{3}$$

$$\alpha(t) = \frac{36K}{4\left\{\mathbb{E}[t|t \in (t_i, t_{i+1})]\right\}^2 + 9\text{Var}[t|t \in (t_i, t_{i+1})]}$$

for all $t \in (t_i, t_{i+1})$.

- The partition is defined implicitly by

$$(1-\alpha(t'))\frac{(t_i - q_2(t'))^2}{4} = (1-\alpha(t''))\frac{(t_i - q_2(t''))^2}{4}$$

for $t' \in (t_{i-1}, t_i)$, $t'' \in (t_i, t_{i+1})$, and $i = 1, \ldots N-1$.

- Corollary 2: The literal reporting strategy that supports the equilibrium above is $m(t) = (t_i, t_{i+1})$ for all $t \in (t_i, t_{i+1})$.

Proof of Proposition 4

- Since any monotonic, bounded function is discontinuous at most countably many times, we can enumerate the points of discontinuity of $q_2(t)$.
- Corollary 1 and Proposition 3: $q_2(t)$ cannot be strictly increasing on any interval $\Rightarrow$ it can only be increasing at the points of discontinuity, i.e., it must be a step function
- Now let m_i be a message inducing the equilibrium outcome on t_i, t_{i+1} and let $M(m_i)$ be the set of all messages which induce the same outcome as m_i. Since q_2 is monotonic, $m(t) \in M \Leftrightarrow t \in (t_i, t_{i+1})$
- Letting $g(m)$ be the marginal density of $f(t, m)$, since $q_2 \equiv \mathbb{E}[t|m]/3$ we have

$$\int_M q_2(m)g(m)dm = \int_M \frac{\mathbb{E}[t|m]}{3} g(m)dm$$

Proof of Proposition 4

- Since q_2 is locally constant on M, this gives $q_2 = \frac{\mathbb{E}[t|m \in M(m_i)]}{3}$ for all $m \in M(m_i)$.
- This is equivalent to (since $m(t) \in M(m_i) \Leftrightarrow t \in (t_i, t_{i+1})$)

$$q_2(t) = \frac{\mathbb{E}[t|t \in (t_i, t_{i+1})]}{3} \forall\ t \in (t_i, t_{i+1})$$

- Finally, to prove Eq. (14) (the cutoff equation) by contradiction, suppose there were strict inequality. Then by continuity we would have $\hat{t} \in (t_i, t_{i+1})$ such that the inequality is satisfied with t_i is replaced with $\hat{t}$; but then $q_2(\hat{t}) \neq q_2(t'')$.

Proposition 5 (Informative Equilibria)

- Proposition 4 alone admits the possibility of unique noninformative equilibria. The goal of Proposition 5 is to establish when these equilibria are informative:
- Proposition 5: There exists an informative disclosure equilibrium when K is neither too small nor too large. That is, whenever $\underline{K} < K < \overline{K}$, there is an informative disclosure; further, $\underline{K}$ and $\overline{K}$ are bounded above and below by $\underline{\underline{K}}$ and $\overline{\overline{K}}$, which in turn are bounded below by 0 and above by $\frac{4\mu^2+9\sigma^2}{36}$. $\underline{K}$ and $\overline{K}$ are defined by

$$\underline{K} = \frac{(\mu - \underline{t})(5\underline{t} - \mu}{3(\mu - \underline{t})(3\underline{t} + \mu) + 9\sigma^2} \frac{4\mu^2 + 9\sigma^2}{36}$$

$$\overline{K} = \frac{(\mu - \overline{t})(5\overline{t} - \mu}{3(\mu - \overline{t})(3\overline{t} + \mu) + 9\sigma^2} \frac{4\mu^2 + 9\sigma^2}{36}$$

Proposition 5

- Sketch of proof: Recall from Crawford and Sobel that if there is a partition equilibrium with N subintervals, then there is also a partition equilibrium for each size $n = 1, 2, \dots N$. Therefore, to find "informative" equilibria, it suffices to find two-element partition equilibria.
- Given this, compute expressions for $K(\underline{t})$ and $K(\overline{t})$ and derive conditions for $\underline{t}, \overline{t}$ such that $K(\overline{t}) > K(\underline{t}$; then apply the intermediate value theorem.

Proposition 5

- Proposition 5 (and Corollary 3, for uniform distributions) generalize Proposition 1, in the sense that if K is sufficiently large, the capital market effect is too dominant whereas if K is sufficiently small, the product market effect is too dominant.
- Considering the special case of the two-element equilibrium, as K increases, higher firm types disclose more precise information while lower tpyes make their disclosures noisier.
- Equivalently (again in the two-element equilibrium), as the relative level of proprietary costs increases, lower types disclose more precise information while higher types disclose less precise information.