Strategic Communication with Lying Costs

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Introduction

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  - Crawford-Sobel (1982)
- Verifiable disclosure (hard information): lying is impossible
  - Milgrom (1981); Grossman (1981)

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- Verifiable disclosure (hard information): lying is impossible
  - Milgrom (1981); Grossman (1981)
- But lying is often feasible albeit costly, for various reasons
  - Technological
  - Legal
  - Psychological/moral

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- $k = 0 \Leftrightarrow$ cheap talk; $k = \infty \Leftrightarrow$ verifiable disclosure
- This paper: $k \in (0, \infty)$, especially interested in moderate values

Introduction

- Some of the main results
  - No full separation for any finite k
  - Characterize a natural class of partially-pooling equilibria
    - formally justified by variation of D1 refinement criterion
    - inflated language
    - low types separate; high types pool
  - Comparative statics with lying cost intensity
  - Unify polar results of cheap talk and verifiable disclosure for large biases
- Application to Delegation vs. Communication (Dessein, 2002)

Related Literature

- Kartik, Ottaviani, and Squintani (2007 JET)
- Ottaviani and Squintani (2006 IJGT)
- Chen (2007)
- Chen, Kartik, and Sobel (2008 ECMA)

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- Austen-Smith and Banks (2000 JET)
- Bernheim and Severinov (2003 JPE)
- Mailath (1987 ECMA)

Model: Basics

- Sender (S) and Receiver (R)
- S has type $t \in [0, 1]$, prior density $f(t) > 0$
- R takes an action $a \in \mathbb{R}$

- Sender utility $U^S(a, t)$: $U^S_{11} < 0$, $U^S_{12} > 0$
- Receiver utility $U^R(a, t)$: $U^R_{11} < 0$, $U^R_{12} > 0$
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- Example
  - $f(t) = 1$
  - $U^R(a,t) = -(a-t)^2$
  - $U^S(a,t) = -(a-t-b)^2$, $b > 0$ bias

Model: Lying Costs

- S sends R a message about his type, $m \in M$
  - $M = \bigcup_t M_t$, with $M_t \cap M_{t'} = \emptyset$ if $t \neq t'$
  - Rich language: for all t, $|M_t| = \infty$ (suff. large)
- Hence, there is a function $\Psi : M \rightarrow T$
  - Interpret: m has the literal meaning *"my type is $\Psi(m)$"*

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- Hence, there is a function $\Psi : M \rightarrow T$
  - Interpret: m has the literal meaning *"my type is $\Psi(m)$"*
- m is payoff-relevant to S, with a cost $k \cdot C(\Psi(m), t)$
  - $k > 0$ and $C_{11} > 0 > C_{12}$
  - Hence, $\exists$ weakly increasing $r^S : T \rightarrow T$ s.t.

$$r^S(t) := \arg\min_{t' \in T} C(t', t)$$

  - For talk, assume r^S is strictly incr. with range $[0, 1]$
- EXAMPLE: $C(t', t) = (t' - t)^2 \quad \Rightarrow r^S(t) = t$

Model: Timing

- Timing
  1. S privately learns Nature's draw of his type t
  2. S sends message, m, to R
  3. R takes her action, a
- Payoffs: $U^R(a,t)$ and $U^S(a,t) - kC(\Psi(m),t)$
- Everything common knowledge except value of t

Strategies and Equilibrium

- S strategy is $\mu : T \rightarrow M$; define $\rho := \Psi \circ \mu$
- R beliefs is a cdf $G(t \mid m)$
- R strategy is $\alpha : M \rightarrow \mathbb{R}$
- Monotone pure strategy Perfect Bayesian Equilibrium:
  1. Best responses & Bayes rule
  2. $\rho(t) \geq \rho(t')$ if $t > t'$

No Separating Equilibria

Lemma

If types (t_l, t_h) *are separating in a monotone equilibrium, then for each* $t \in (t_l, t_h)$*,*

$$\rho(t) > r^S(t)$$

and

$$\rho'(t) = \frac{U_1^S\left(a^R(t), t\right)\frac{da^R}{dt}(t)}{kC_1(\rho(t), t)}. \tag{DE}$$

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Theorem

There is no separating equilibrium.

Intuition

- Can show that separating equilibrium must be monotone (using $r^S(0) = 0$)
- By Lemma, language must be inflated throughout, but one "runs out" of types to mimic because $r^S(1) = 1$

LSHP Equilibria

- Barrier to full separation is $\rho = 1$, hence focus on equilibria with separation up to some type $\underline{t}$ and then partial-pooling on highest messages.
- Riley condition (LCSE) $\Rightarrow \rho(0) = r^S(0) = 0$
- Separating Function is any function that solves (DE) with the initial condition $\rho(0) = 0$.

Lemma

There is a unique separating function, ρ^*, whose maximal domain is $[0, \overline{t}]$, with $\overline{t} \in (0, 1)$.

LSHP Equilibria

Definition

A Sender's strategy μ is a LSHP (Low types Separate and High types Pool) strategy if there exists $\underline{t} \in [0, \bar{t}]$ such that:

1. for all $t < \underline{t}$, $\rho(t) = \rho^*(t)$
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Remark

- Types in $[\underline{t}, 1]$ need not form a single pool, since $|M_1| = \infty$ (rich language assumption)
- Bernheim & Severinov's (2003) "mD1" forward-induction refinement selects precisely LSHP equilibria (up to off path differences)

LSHP Equilibria

Theorem (Existence and Characterization)

In any LSHP equilibrium, there is a cutoff type, $\underline{t} \in [0, \overline{t}]$*, and a partial-partition,* $\langle t_0 = \underline{t}, t_1, \ldots, t_J = 1 \rangle$*, such that*

$$U^S(a^R(t_{j-1}, t_j), t_j) - U^S(a^R(t_j, t_{j+1}), t_j) = 0 \qquad \forall j \in \{1, \ldots, J-1\}, \tag{1}$$

$$U^S(a^R(\underline{t}, t_1), \underline{t}) - kC(1, \underline{t}) = U^S(a^R(\underline{t}), \underline{t}) - kC(\rho^*(\underline{t}), \underline{t}) \quad \text{if } \underline{t} > 0. \tag{2}$$

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Conversely, given any cutoff type and partial-partition that satisfy (1), (2)*, and*

$$U^S(a^R(\underline{t}, t_1), 0) - kC(1, 0) \geq U^S(a^R(0), 0) - kC(0, 0) \quad \text{if } \underline{t} = 0, \tag{3}$$

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For any $k > 0$*, there is an LSHP equilibrium. If* k *is sufficiently large, there is an LSHP equilibrium with* $\underline{t} > 0$*.*

LSHP Equilibria

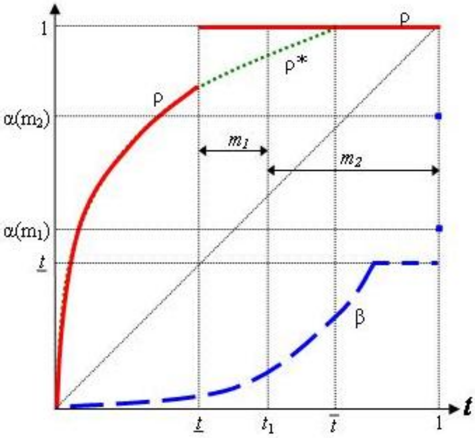

Figure: A LSHP equilibrium: solid red curve represents Sender's strategy via $\rho(t)$; dotted green curve is the separating function, ρ^*; dashed blue curve represents Receiver's strategy via $\beta(t) = \cup_{m \in M_t} \alpha(m)$.

LSHP Equilibria

Proposition (Comparative Statics)

1. *As $k \to 0$, $\overline{t}(k) \to 0$.*
2. *If k is small, every LSHP eqm is close to the "most informative" CS equilibrium (cf. Chen, Kartik, and Sobel 2008).*

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3. *For large k, every LSHP eqm has a single pool.*
4. *As $k \to \infty$, $\underline{t}(k) \to 1$ in every sequence of LSHP equilibria*

$\Rightarrow$ *converge to full separation*

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3. *For large* k, *every LSHP eqm has a single pool.*
4. *As* $k \to \infty$, $\underline{t}(k) \to 1$ *in every sequence of LSHP equilibria*

   $\Rightarrow$ *converge to full separation*

5. *If conflict of interest is large* ($a^S(0) > a^R(1)$), *every LSHP eqm has a single pool.*

Withholding Information

- Verifiable disclosure models allow the Sender to withhold information but not lie
- Under large conflict of interest
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Withholding Information

- Verifiable disclosure models allow the Sender to withhold information but not lie
- Under large conflict of interest
  - cheap talk $\Rightarrow$ only uninformative equilibria
  - verifiable disclosure $\Rightarrow$ full revelation
- Section 5 of the paper shows that the costly lying model can be extended to allow withholding at no cost, and that LSHP equilibria extend naturally
- LSHP equilibria span the two polar predictions of $k = 0$ and $k = \infty$, with specific predictions about the eqm *language*

Application: Delegation vs. Communication

Leading example: uniform-quadratic of CS with quadratic lying costs

Proposition

In the leading example, there is a finite $\hat{k}$ such that for any $k \geq \hat{k}$, communication is superior to delegation for all $b > 0$. In particular, if $k \geq \frac{1}{4}$ and $b \in (0, \frac{3}{16})$, communication is superior to delegation.

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Remark

1. Dessein (2002, ReStud) showed that under cheap talk, comm $\succ$ del iff b is large.
2. Straightforward that for any fixed $b > 0$, comm $\succ$ del iff k is large enough.
3. Proposition shows that threshold $k(b)$ does not diverge to infinity as $b \to 0$.

Application: Delegation vs. Communication

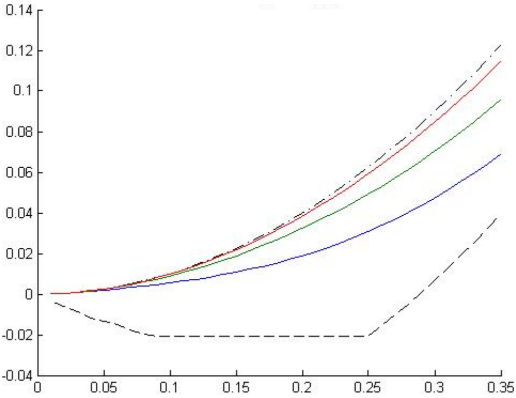

Figure: Receiver's ex-ante welfare gain from communication over delegation as a function of the bias, b, in leading example. Highest curve is b^2, $(k = \infty)$; next three are for single-pool LSHP equilibrium with $k = 1$, $k = 0.5$, and $k = 0.25$ respectively; lowest curve is for most-informative equilibrium of cheap talk.

Costly Lying from Behavioral Cheap Talk

- Messages are costless
- Prob $q \in (0, 1)$, R naively plays $a = a^R(\Psi(m))$
- Prob $1 - q$, R rationally plays $a = \alpha(m)$

$\Rightarrow$ Payoff for S:

$$(1 - q)U^S(\alpha(m), t) + qU^S(a^R(\Psi(m)), t)$$

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$$\downarrow$$

$$U^S(\alpha(m),t) - kC(\nu(\Psi(m)),t)$$

where $k \equiv \frac{q}{1-q}$, $\nu(\cdot) = a^R(\cdot)$, $C(x,t) \equiv -U^S(x,t)$

- more general model in the paper handles this setting as well

Conclusion

- A model of communication with costly lying
- Language inflation arises naturally, even when information is transmitted very precisely (large costs)
- Intuitive comparative statics with cost intensity
- Costly lying provides a bridge between verifiable disclosure and cheap talk models
- Model can be used in applications: an example to question of delegation vs. communication