Non-monotonic Disclosure in Policy Advice

Anna Denisenko (U. Chicago), Catherine Hafer (NYU), and Dimitri Landa (NYU)

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Motivation

Strategic communications between policymakers and bureaucratic agencies

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- Preference misalignment under verifiable information $\rightarrow$ full disclosure (Milgrom (1981), Grossman (1981))

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Disclosure Games

- Preference misalignment under verifiable information $\rightarrow$ full disclosure (Milgrom (1981), Grossman (1981))
  - monotonicity of Sender preferences in Receiver action

Some Results

1. When ex-ante preferences of sender and receiver sufficiently co-align, disclosure may be partial, contrary to standard *unraveling* results
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   - introduce a novel equilibrium refinement: belief stability
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   - no uncertainty about informedness of Sender

2. For sufficient co-alignment, there is multiplicity of Sequential Equilibria
   - introduce a novel equilibrium refinement: belief stability
   - belief-stable equilibria exhibit different comparative statics than belief-unstable equilibria

3. Robust prediction that more ex-ante preference divergence yields more information disclosure, contrary to cheap-talk results

Our Contributions

- Full disclosure in games of verifiable advice:
  - **Milgrom** (1981), **Grossman** (1981), **Milgrom** (2008)
  - **Seidmann and Winter** (1997)
    - objective function concave in action
    - sender's utility more state-dependent than receiver's
- Partial disclosure in games of verifiable advice
  - uninformed sender **Dye** (1985), **Jung and Kwon** (1988)
  - uncertainty about S's preferences **Wolinsky** (2003), **Dziuda** (2011)
  - multidimensional advice **Callander, Lambert and Matouschek** (2021)
  - disclosure reward **Denisenko, Hafer and Landa** (2024)
- Games of communication within hierarchy (cheap talk)
  - divergence in preferences $\rightarrow$ worse communication: seminal paper by **Crawford and Sobel** (1982), **Gilligan and Kreihbiel** (1987), **Austen-Smith** (1990, 1993)
  - **Callander** (2008)

Road Map

1. Introduction
2. Uniform Prior, Quadratic Preferences, State-independent Sender Preferences
   - Game Structure
   - Equilibrium Characterization
   - Effects of Preference Divergence
   - Belief Stability Equilibrium Refinement
3. General Model
   - Equilibria
   - Comparative Statics
4. Robustness
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Actors and Timing

Two players: Agency (it) and Policymaker (she).

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③	Agency chooses message (m) to send to Policymaker	$m \in \{\omega, \varnothing\}$

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②	Agency observes state (ω)	ω
③	Agency chooses message (m) to send to Policymaker	$m \in \{\omega, \varnothing\}$
④	Policymaker observes m and chooses policy (p)	$\mathrm{p} \in \mathbb{R}$

Uniform Prior and Quadratic Preferences: Payoffs and Solution Concept

- Agency:

$$u_A(p) = -(p - i)^2$$

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Solution Concept: Sequential Equilibrium.

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Equilibrium Characterization

In every equilibrium

Policymaker

- $p^*(m = \omega) = \omega$ when $m \neq \varnothing$;
- $p^*(m = \varnothing) = x^* \equiv E[\omega | m^*(\omega) = \varnothing]$, where $m^*(\omega)$ is A's eq. disclosure strategy.

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Agency

- discloses ω when $\omega \in [i - \sqrt{(x^* - i)^2}, i + \sqrt{(x^* - i)^2}] \cap [-1, 1]$;
- conceals ω otherwise.

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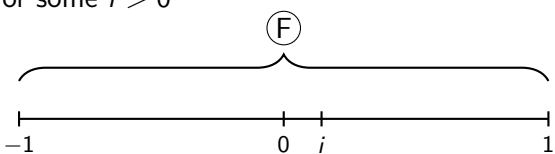
$i \geq 0 \rightarrow$ disclose $\omega \in [x^*, 2 \cdot i - x^*] \cap [-1, 1]$;
$i \leq 0 \rightarrow$ disclose $\omega \in [2 \cdot i - x^*, x^*] \cap [-1, 1]$.

Equilibrium Disclosure Strategies

There can be a *maximum* of three disclosure strategies supported in equilibrium

1. **Full disclosure (F)**

Disclosure intervals for some $i > 0$



Hatched areas – no disclosure

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2. **Partial disclosure:**
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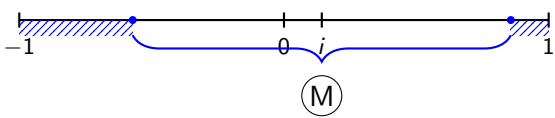

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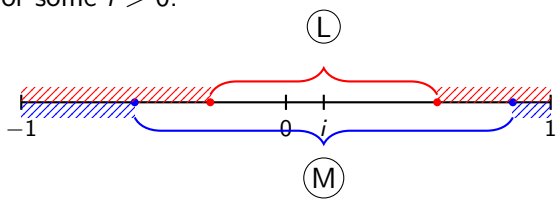

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Equilibria

There can be a *maximum* of three equilibria

1. Full disclosure equilibrium;
2. Partial disclosure equilibria:
   - More Expansive equilibrium,
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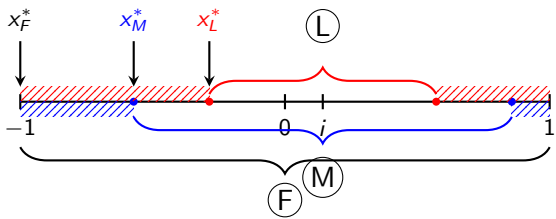

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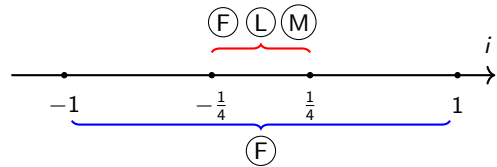
Effect of Preference Divergence ($|i|$) on Full Disclosure Equilibrium Uniqueness

Prop.1

1. For all i there exists full disclosure equilibrium;
2. If and only if $|i| \leq 1/4$, there are two partial disclosure equilibria: **less expansive** and **more expansive**.



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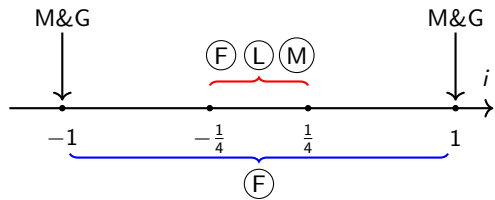

Effect of Preference Divergence ($|i|$) on Equilibrium Disclosure

Assume $i \geq 0 \rightarrow$

Agency discloses ω to PM when

$$\omega \in [x^*, 2 \cdot i - x^*] \cap [-1, 1],$$

and conceals information otherwise.

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- Direct effect always (*weakly*) improves communication between A and PM
- Indirect effect
  - $\rightarrow$ Improves communication in **less expansive** equilibrium

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  - $\rightarrow$ Reduces communication in **more expansive** equilibrium

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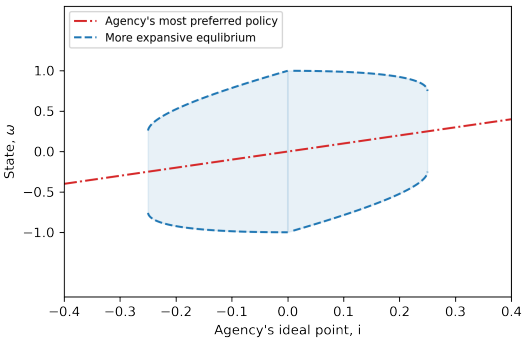

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Communication between actors

$\rightarrow$ *deteriorates* in $|i|$ in more expansive equilibrium;

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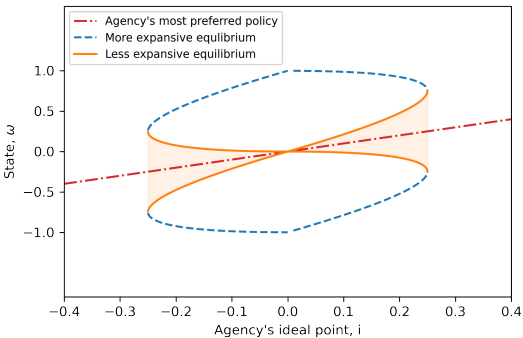

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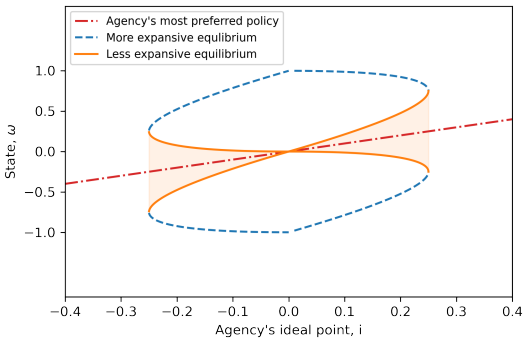

Prop.2

Communication between actors

- → *deteriorates* in $|i|$ in more expansive equilibrium;
- → *improves* in $|i|$ in less expansive equilibrium; and
- → *not affected* by $|i|$ in full disclosure equilibrium.

Comparative Statics Underlying Intuition

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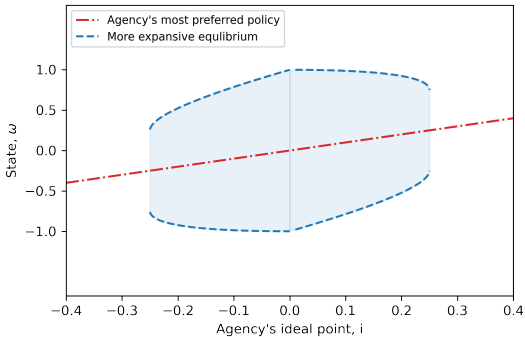
Belief-Stability: Motivation

We have multiple equilibria with contrary comparative statics:

- More expansive $\rightarrow$ communication deteriorates in ex-ante preference misalignment
- Less expansive $\rightarrow$ communication improves in ex-ante preference misalignment

All survive standard refinements $\rightarrow$ Which one should we expect?



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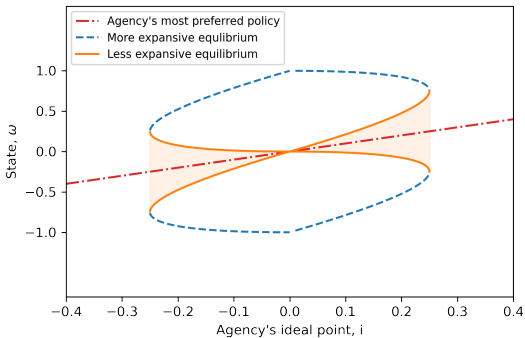


Belief-Stable Equilibria

Definition: Belief Stable

Consider an equilibrium (σ, μ).

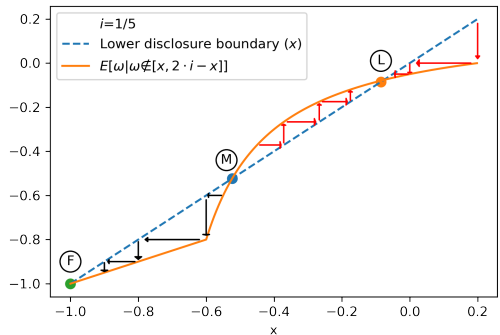
Let μ_j^ε be j's perturbed system of beliefs.

Let σ^ϵ be seq. rational given $(\mu_j^\varepsilon, \mu_{-j})$.

Let $\hat{\mu}_j^\varepsilon$ be consistent with σ^ε.

If there exists an $\varepsilon > 0$ such that, for every μ_j^ε that satisfies $|\mu_j^\varepsilon(y) - \mu_j(y)| < \varepsilon$, $|\hat{\mu_j^\varepsilon}(y) - \mu_j(y)| \leq |\mu_j^\varepsilon(y) - \mu_j(y)|$ is satisfied for every decision node y of j

$\Rightarrow$ Equilibrium (σ, μ) is **belief-stable** (for j)



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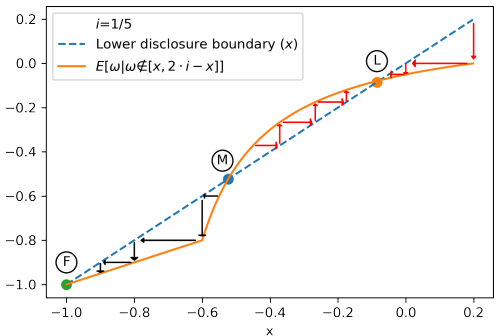
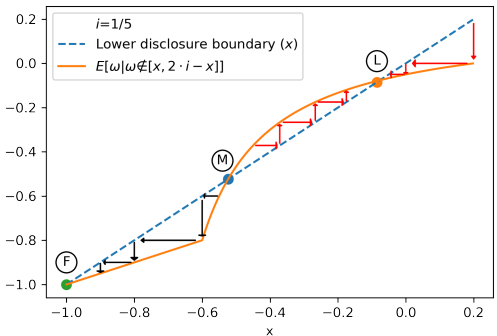


Prop.3

1. More expansive equilibrium is not belief-stable

Belief-Stable Equilibria



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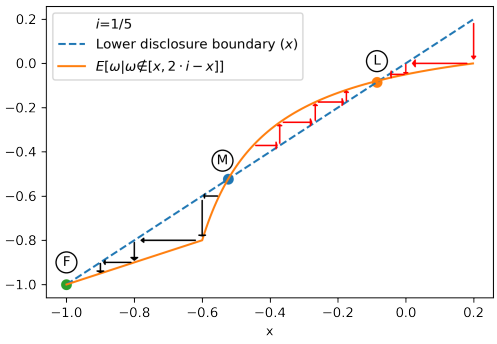
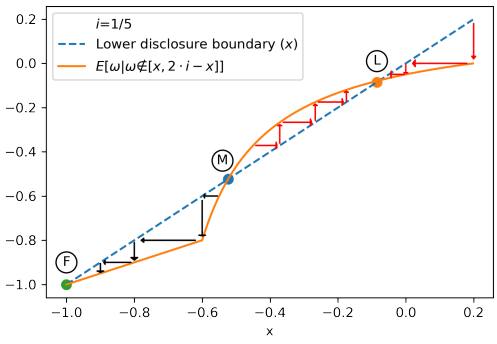


Prop.3

1. More expansive equilibrium is not belief-stable;
2. Less expansive equilibrium is belief-stable;

$\Rightarrow$ **Corollary 1.** Equilibrium is belief-stable $\Leftrightarrow$ communication **improves** in pref. divergence. Equilibrium is not belief-stable $\Leftrightarrow$ communication **worsens** in pref. divergence.

Belief-Stable Equilibria



Prop.3

1. More expansive equilibrium is not belief-stable;
2. Less expansive equilibrium is belief-stable;
3. Full disclosure is belief-stable when $i \neq 0$.

$\Rightarrow$ **Corollary 1.** Equilibrium is belief-stable $\Leftrightarrow$ communication **improves** in pref. divergence. Equilibrium is not belief-stable $\Leftrightarrow$ communication **worsens** in pref. divergence.

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General Model: Actors and Timing

Two players: the Agency (it) and the Policymaker (she).

①	Nature determines state of the world $\omega \in \Omega$: Ω is compact and $conv(\Omega) = [\underline{\omega}, \overline{\omega}]$	$\omega \sim F(\cdot)$ such that $\int_{\underline{\omega}}^{\overline{\omega}} x \cdot f(x)dx = 0$
②	Agency observes ω	ω
③	Agency chooses message (m) to send to Policymaker	$m \in \{\omega, \varnothing\}$
④	Policymaker observes m and chooses policy (p) to implement	$p \in \mathbb{R}$

$$p^P(\omega) := \arg\max_p u_P(p; \omega) = \omega$$

$$p^A(\omega, \alpha, i) := \arg\max_p u_A(p; \omega, \alpha, i) = \alpha \cdot p^P(\omega) + (1 - \alpha) \cdot i$$

Full-Disclosure Equilibria

Proposition

1. 1. If $u_A(p^P(\overline{\omega}); \overline{\omega}, \alpha, i) > u_A(p^P(\underline{\omega}); \overline{\omega}, \alpha, i)$, then for all conditions on primitives such that there exists a full-disclosure equilibrium s.t. $x^* = p^P(\underline{\omega})$, that equilibrium is belief-stable;
   2. If $u_A(p^P(\overline{\omega}); \overline{\omega}, \alpha, i) = u_A(p^P(\underline{\omega}); \overline{\omega}, \alpha, i)$, then for all conditions on primitives, such that there exists a full-disclosure equilibrium s.t. $x^* = p^P(\underline{\omega})$, that equilibrium is belief-unstable;
   3. If $u_A(p^P(\overline{\omega}); \overline{\omega}, \alpha, i) < u_A(p^P(\underline{\omega}); \overline{\omega}, \alpha, i)$, there does not exist a full-disclosure equilibrium such that $x^* = p^P(\underline{\omega})$.
2. (Seidman and Winter 1997) There exists a full-disclosure equilibrium if the Agency's utility, $u_A(\cdot)$, satisfies single-crossing.

Non-Disclosure Equilibria

Proposition

1. There exists a unique threshold $\alpha^* \in (0,1)$ such that a non-disclosure equilibrium exists if and only if the Agency's bias $i = p_0^P$ and preference state-dependence $\alpha \leq \alpha^*$.
2. A non-disclosure equilibrium is belief-stable.

Partial-Disclosure Equilibria

Proposition

There exists a threshold $\alpha^{**} \in [\alpha^*, 1)$ and, $\forall \alpha \leq \alpha^{**}$, an interval $I^*(\alpha) \subset \Omega$ containing p_0^P such that $G \in \mathcal{G}$ has a partial-disclosure equilibrium if and only if $\alpha \leq \alpha^{**}$ and $i \in I^*(\alpha)$.

Equilibrium Pattern

Proposition

1. For any distinct x_j^* and x_k^*,

$$M(x_k^*, \alpha, i) \subseteq M(x_j^*, \alpha, i) \Leftrightarrow u_A(x_k^*; \omega, \alpha, i) \geq u_A(x_j^*; \omega, \alpha, i).$$

2. Index set $X^*(\alpha, i)$ s.t. if $j < k, x_j^* < x_k^*$. Then the belief-stability of equilibria alternates along this ordering, i.e., if the equilibrium corresponding to x_j^* is belief-stable, then the equilibrium corresponding to to x_{j+1}^* (if it exists) is not belief-stable and the equilibrium corresponding to x_{j+2}^* (if it exists) is.

Corollary

For any given (α, i), knowing the belief-stability of one equilibrium is sufficient to determine the belief-stability of all equilibria.

General Model: Comparative Statics

Proposition

The equilibrium policy absent disclosure, x^*, is

1. decreasing in the Agency's bias, i; and
2. increasing in the Agency's preference state-dependence, α, when $x^* < i$, and decreasing in α otherwise,

if and only if the equilibrium is belief-stable.

Proposition

The equilibrium disclosure interval, $M(x^*, \alpha, i)$, is

1. expanding in the Agency's bias, i, when $x^* \leq i$, and contracting in i otherwise; and
2. expanding in the Agency's preference state-dependence, α

if and only if the equilibrium is belief-stable.

Comparative Statics Cont'd

When is $x^* < i$?

Remark

When

1. distance-based utilities,
2. α not too large, and
3. the tails of the prior density $f(\omega)$ are not too asymmetric

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Robustness

- Messages are Partially Verifiable
  - retain equilibrium partial disclosure
  - disclosure increases in i
- Vague Messages
  - retain equilibrium partial disclosure
  - disclosure increases in i

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Summary

A model of **verifiable communication** between a Policymaker and a Bureaucratic Agency:

1. When Agency and Policymaker's ex-ante preferences are sufficiently aligned, unraveling may stop before being complete;
2. Greater ex-ante preference divergence can encourage Agency to disclose more information;
3. Equilibria where communication improves with preference divergence are belief-stable.

Thank you!