Discussion of "Persuasion in Global Games with an Application to Stress Testing" by Nicolas Inostroza and Alessandro Pavan

Stephen Morris

IUB Stern Workshop March 2017
Some policy ingredients:

- "stress tests": reveal information to a set of market participants to influence their behavior
- "bank runs": there are strategic complementarities involved in partially informed market participants’ decisions to run from a bank, a financial institution more generally, or a banking and financial system

Modelling ingredients:

- information design
- coordination games

This excellent paper combines these ingredients in a canonical model to study important questions and obtain insightful results
Global game model of regime change: continuum of players decide whether to attack or not; regime failure if enough attack relative to a fundamental state ("strength of regime"), state observed with noise, players want to attack conditional on the regime failing

Policy maker wants to prevent failure

Policy maker commits to information provision as a function of the fundamental state (and maybe players’ signals)

Worst rationalizable outcome will be played
Summary: Three Questions

1. Policy maker can condition information on players’ signals (discriminatory)

2. Policy maker can condition information on players’ signals only if players willing to report them truthfully

3. Policy maker cannot condition information on players’ signals (non-discriminatory)

- paper studies (1) and (3).... (2) for future work?
- fits cleanly and interestingly into larger literature on "information design":
  - Bergemann-Morris 17 "Information Design: A Unified Perspective":
  - many players, information designer with own information, adversarial equilibrium selection so no revelation principle, 2 out of 3 cases about conditioning on private information....
Results I will Focus On and Try and Explain

- In non-discriminatory case:
  - perfect coordination
  - structural but no strategic uncertainty
  - monotone disclosure is optimal / "pseudo revelation principle"

- In discriminatory case:
  - still perfect coordination
  - structural AND strategic uncertainty
  - complicated disclosure / no pseudo revelation principle
  - one can do better in the discriminatory case than in the non-discriminatory case with complicated disclosure policies
Some Key Ideas in Toy Example

<table>
<thead>
<tr>
<th>bad state:</th>
<th>stay</th>
<th>run</th>
</tr>
</thead>
<tbody>
<tr>
<td>bank may fail</td>
<td>x, x</td>
<td>−1, 0</td>
</tr>
<tr>
<td>stay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>run</td>
<td>0, −1</td>
<td>0, 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>good state:</th>
<th>stay</th>
<th>run</th>
</tr>
</thead>
<tbody>
<tr>
<td>bank survives for sure</td>
<td>x, x</td>
<td>x, 0</td>
</tr>
<tr>
<td>stay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>run</td>
<td>0, −1</td>
<td>0, 0</td>
</tr>
</tbody>
</table>

with $x > 0$, probability of bad state $1 - \hat{\varepsilon}$ (small $\varepsilon$) and only player 1 knows the state initially

- bank fails if the state is bad and someone runs
- policy maker does not want the bank to fail
can’t do better than advising both players to stay when the state is good and stay with probability \( \alpha = \frac{\varepsilon}{1-\varepsilon} x \) when the state is bad, i.e., with ex ante probability

\[
\varepsilon + \frac{\varepsilon}{1-\varepsilon} x = \varepsilon \left( 1 + \frac{x}{1-\varepsilon} \right)
\]

probability \( \alpha \) solves

\[
\frac{\varepsilon}{\varepsilon + (1-\varepsilon) \alpha} x + \frac{(1-\varepsilon) \alpha}{\varepsilon + (1-\varepsilon) \alpha} (-1) = 0
\]

perfect coordination, structural not strategic uncertainty, monotonic revelation, pseudo revelation principle
endow players with "e-mail" incomplete information structure (meta-theorem: anything about higher order beliefs can be illustrated with e-mail example; this includes global games)

- State space $\Omega = \{1, 2, \ldots, \ldots, \infty\}$
- state good at state 1 only, otherwise bad
- 1’s partition: ($\{1\}, \{2, 3\}, \{4, 5\}, \ldots, \{\infty\}$)
- 2’s partition ($\{1, 2\}, \{3, 4\}, \ldots, \{\infty\}$).
- probability of state $\omega \neq \infty$ is $\varepsilon \left(\frac{1-q}{q}\right)^{\omega-1}$.
Rationalizable Outcomes

- If $q > \frac{1}{1+x}$ (stay is unique best response if you expect other player to stay with probability $q$), unique rationalizable outcome is stay for all $\omega \neq \infty$
- if $x > 1$ (stay is strictly risk dominant), stay can be made uniquely rationalizable always (set $q = \frac{1}{2} + \eta$ for some $\eta(\varepsilon)$)
- if $x < 1$, can make probability of staying uniquely rationalizable with probability

$$\varepsilon + \varepsilon \left( \frac{1 - q}{q} \right) + \varepsilon \left( \frac{1 - q}{q} \right)^2 + \ldots = \frac{q}{2q - 1} \varepsilon$$

and thus arbitrarily close to $\frac{1}{1-x} \varepsilon$ (and more than the non-discriminatory case)
- cannot do better (Kajii and Morris (1997))
- perfect coordination, no pseudo revelation principle
stressed tests with one player: best to pool together as many somewhat bad banks with good banks and cut loose very bad banks... key insight in a bunch of settings including Kamenica-Gentzkow (2011) and Goldstein-Leitner (2015)
non-discriminatory case generalizes this insight naturally [note: adversarial equilibrium not relevant with one player]
optimal discriminatory policy is not super convincing in practise (authors suggest)...
- (authors) when is non-discriminatory information design enough? what happens when restricted class of revelation strategies?
- can paper's policy implications be structured as....
  - sometimes best to use non-discriminatory policy
  - sometimes best to give noisy accurate information (ignoring prior information)
  - sometimes best to use interaction of the two

prior information of players always bad
Thanks for the opportunity to read and discuss
Nice Paper!
• excellent modelling choices
• extensions/alternatives:
  • new round of noise added / unique selection after arrival of information
Information Designer picks (and commits to information structure) to communicate with perhaps informed players. Three cases:

1. Many players but uninformed information designer has no information of her own (e.g., "Bayesian games with communication", Myerson 91)
2. Single player, informed information designer (e.g., "Bayesian persuasion", Kamenica-Gentzkow 11)
3. Many players, informed information designer (e.g., "Bayes correlated equilibrium", Bergemann-Morris 13, 16)

- all appeal to revelation principle
- revelation principle relies (as elsewhere) on picking the right equilibrium for the designer; much harder with adversarial equilibrium choice
- this paper studies the many player information design problem with informed designer, prior information and adversarial equilibrium choice
• What can the information designer do about players’ private information? Three cases....

  1. Condition on it (omniscient?)
  2. Elicit it
  3. No elicitation

• In uninformed information designer (=mediator) case

  1. Bayesian solution
  2. communication equilibrium
  3. strategic form correlated equilibrium

• In this adversarial equilibrium case

  1. discriminatory case
  2. ???
  3. non-discriminatory case
Robustness to Incomplete Information

1. Robustness to incomplete information (Kajii-Morris 97 and follow up literature)
   - Fix a complete information game
   - Consider games of incomplete information where payoffs are almost always given by that complete information game
   - Which equilibria of the complete information have the property that they are always played with high probability in all such incomplete information games?

2. When there is noise independent selection in global games, must be a robust equilibrium played...

3. Sufficient conditions include risk dominance (in 2x2 games), Laplacian (in 2 action many player games), potential maximizing...
• Carroll (2016): nice adversarial equilibrium example
• comparison with Angeletos et al 06 and others: commitment surely is dubious in this application
• Morris-Shin-Yildiz 16: general characterization of unique Laplacian selection on universal type space
• Detailed comparison with Goldstein-Huang 16
• Morris-Shin 03: global game / robustness connection
• Bergemann-Morris 16: prior information always bad (in different context)