Informing to Divert Attention

Margarita Kirneva

CREST - Ecole Polytechnique

August 28, 2023
EEA-ESEM congress

Introduction

- Consider an interaction between a policy-maker and an informational lobbyist over 2 policy issues
- The lobbyist and the policy-maker may have aligned interests on both, on one of them or misaligned on both
- The lobbyist provides policy-relevant information to the policy-maker
- The policy-maker may access some additional information afterwards prior to making the decisions
- The lobbyist is strategic and chooses the type of information and its quality to make her preferred policies more likely

Introduction

In such framework lobbyist's information has two effects:

- Informing policy-maker to assure better decision
- Directing policy-maker's own search for information (to influence which issues are under PM's attention)

Introduction

In such framework lobbyist's information has two effects:

- Informing policy-maker to assure better decision
- Directing policy-maker's own search for information (to influence which issues are under PM's attention)

Questions:

- Can the lobbyist influence Receiver's information acquisition to her benefit in the presence of a conflict of interests?
- Can more information be harmful for the policy-maker?

This paper

- 2-dimensional Sender-Receiver framework with private information acquisition
- Receiver needs to take 2 actions, one for each of the dimensions of the state of the world
- Prior to making a decision Receiver acquires information in 2 stages:
  - Sender strategically provides some information (commitment)
  - Receiver may obtain some additional information afterwards
- Receiver's (and Sender's) access to information is restricted

Preview of the results

– We uncover the new role for the information provision in the presence of a conflict of interests

Preview of the results

- We uncover the new role for the information provision in the presence of a conflict of interests
- When the interests of Sender and Receiver are partially aligned or fully misaligned Sender is facing a trade-off:
  - To provide information on the dimension where interests are aligned if such exists
  - To prevent Receiver from discovering excessively the dimension of (greater) misalignment
- In the latter case Sender provides information in order to divert Receiver's attention

Preview of the results

– We uncover the new role for the information provision in the presence of a conflict of interests

– When the interests of Sender and Receiver are partially aligned or fully misaligned Sender is facing a trade-off:

  - To provide information on the dimension where interests are aligned if such exists
  - To prevent Receiver from discovering excessively the dimension of (greater) misalignment

– In the latter case Sender provides information in order to divert Receiver's attention

– Information provision is possible under fully misaligned interests!

Key intuition

– Receiver looks for information which reduces uncertainty the most ⇒ Receiver learns the most uncertain dimension

Key intuition

- Receiver looks for information which reduces uncertainty the most ⇒ Receiver learns the most uncertain dimension
- To divert attention from the dimension of misalignment Sender:
  - partially reveals this dimension to make it less uncertain
  - which forces Receiver to look for information on the other dimension

Key intuition

- Receiver looks for information which reduces uncertainty the most ⇒ Receiver learns the most uncertain dimension

- To divert attention from the dimension of misalignment Sender:
  - partially reveals this dimension to make it less uncertain
  - which forces Receiver to look for information on the other dimension

Other applications: privacy concerns, hiring process, expert advice ...

Contribution (theory)

1. Bayesian persuasion

   – Multidimensional environment:

     Tamura (2018); Khantadze, Kremer & Skrzypacz (2022)

   – Persuasion with private information acquisition

     Bizotto, Rudiger & Vigier (2020); Matyskova & Montes (2023)

This paper: combines the 2 strands as the only possibility to capture diverting attention motives

Contribution (applications)

2. Lobbying

Cotton & Dellis (2016); Ellis & Groll (2020); Cotton & Li (2018)

This paper: provides new insights on the lobbyist's motives and optimal PM's information

3. Other applications

Duggan & Martinelli (2011); Yuksel & Perego (2021); Yuksel (2021); Biglaiser et al. (2023)

Baseline framework

- 2 agents: Sender (S) and Receiver (R)

Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$

Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
- R needs to take 2 actions: $a \in \mathbb{R}^2$

Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
- R needs to take 2 actions: $a \in \mathbb{R}^2$
- R's payoff:

$$u_R(a, \theta) = -(a_1 - \theta_1)^2 - (a_2 - \theta_2)^2$$

- S's payoff:

$$u_S(a, \theta) = -\sum_{i \in \{1,2\}} \left(\underbrace{\beta_i (a_i - \theta_i)^2}_{\text{correct action}} + \underbrace{(1 - \beta_i)(a_i - a_i^*)^2}_{\text{S's bias}} \right)$$

Baseline framework

- 2 agents: Sender (S) and Receiver (R)
- Unknown state of the world: $\theta \in \mathbb{R}^2$
- R needs to take 2 actions: $a \in \mathbb{R}^2$
- R's payoff:

$$u_R(a,\theta) = -(a_1 - \theta_1)^2 - (a_2 - \theta_2)^2$$

- S's payoff:

$$u_S(a,\theta) = -\sum_{i\in\{1,2\}} \left(\underbrace{\beta_i(a_i - \theta_i)^2}_{\text{correct action}} + \underbrace{(1-\beta_i)(a_i - a_i^*)^2}_{\text{S's bias}} \right)$$

General: $u_i(a,\theta) = \left\| Q_i^\theta \theta + Q_i^a a \right\|^2$

Baseline framework

– S and R share prior beliefs about θ:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix} \right)$$

Baseline framework

– S and R share prior beliefs about θ:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

Baseline framework

- S and R share prior beliefs about θ:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

- S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2)$

Baseline framework

- S and R share prior beliefs about θ:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

- S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2)$

$$S_S = \alpha_{S_1}\theta_1 + \alpha_{S_2}\theta_2 + \varepsilon_S$$

any number of linear signals

Baseline framework

- S and R share prior beliefs about θ:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

- S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2)$

$$S_S = \alpha_{S_1}\theta_1 + \alpha_{S_2}\theta_2 + \varepsilon_S$$

any number of linear signals

- Upon observing realization of S_S, R chooses a signal (dimension+noise):

$$S_R = \theta_j + \varepsilon_R$$

with $\varepsilon_R \sim \mathcal{N}(0, \sigma_R^2)$

Baseline framework

– S and R share prior beliefs about θ:

$$\theta \sim \mathcal{N}\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} v_1 & 0 \\ 0 & v_2 \end{pmatrix} \right)$$

Allow for correlation between the dimensions

– S chooses a signal (dimension+noise):

$$S_S = \theta_i + \varepsilon_S$$

with $\varepsilon_S \sim \mathcal{N}(0, \sigma_S^2)$

$$S_S = \alpha_{S_1}\theta_1 + \alpha_{S_2}\theta_2 + \varepsilon_S$$

any number of linear signals

– Upon observing realization of S_S, R chooses a signal (dimension+noise):

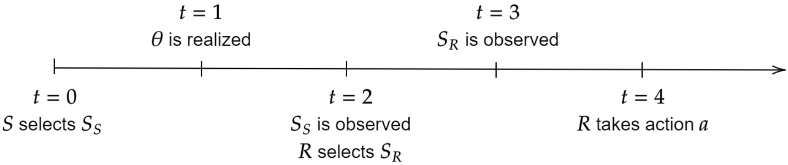
$$S_R = \theta_j + \varepsilon_R$$

with $\varepsilon_R \sim \mathcal{N}(0, \sigma_R^2)$

$$S_R = \alpha_{R_1}\theta_1 + \alpha_{R_2}\theta_2 + \varepsilon_R$$

a unique linear signal

Timeline



$t = 1$
θ is realized
$t = 3$
S_R is observed
$t = 0$
S selects S_S
$t = 2$
S_S is observed
R selects S_R
$t = 4$
R takes action a

Baseline framework

- S is an expert $\Rightarrow$ signal is costless
- R's information is costly :

$$C(\check{v}, \widetilde{v}) = \frac{\lambda}{2}\left(\log \frac{\widetilde{v}}{\check{v}}\right)$$

where $\check{v}$ and $\widetilde{v}$ are the interim and posterior beliefs of R on the dimension of S_R (Mackowiak, Matějka, and Wiederholt (2018))

Baseline framework

- S is an expert $\Rightarrow$ signal is costless
- R's information is costly :

$$C(\check{v}, \widetilde{v}) = \frac{\lambda}{2}\left(\log \frac{\widetilde{v}}{\check{v}}\right)$$

  where $\check{v}$ and $\widetilde{v}$ are the interim and posterior beliefs of R on the dimension of S_R (Mackowiak, Matějka, and Wiederholt (2018))

- Precision-dependent convex costs $c(1/\sigma_R^2)$, for instance

$$c(1/\sigma_R^2) = \frac{\kappa}{\sigma_R^2} \qquad\qquad c(1/\sigma_R^2) = +\infty \cdot \mathbb{1}_{\sigma_R^2 < \bar{\sigma}^2}$$

Baseline framework

$$u_R(a,\theta) = -(a_1-\theta_1)^2 - (a_2-\theta_2)^2$$

It follows:

- $a_R = \mathbb{E}_{\widetilde{F}}[\theta]$
  where $\widetilde{F}$ - posterior belief of R
- $\mathbb{E}_F[u_R(a,\theta)] = -\widetilde{v}_1 - \widetilde{v}_2$
  where $\widetilde{v}_1$, $\widetilde{v}_2$ - posterior uncertainty of R

Baseline framework

$$u_S(a,\theta) = -\sum_{i\in\{1,2\}} \left(\beta_i(a_i-\theta_i)^2 + (1-\beta_i)(a_i-a_i^*)^2\right)$$

It follows (given the optimal actions of R!):

$$\mathbb{E}_F[u_S(a,\theta)] = -(2\beta_1-1)\widetilde{v}_1 - (2\beta_2-1)\widetilde{v}_2$$

- If $\beta_1 > 1/2$, $\beta_2 > 1/2$ - interests are **aligned**
- If $\beta_1 < 1/2$, $\beta_2 < 1/2$ - interests are **misaligned**
- If $(\beta_1 - 1/2)(\beta_2 - 1/2) < 0$ - interests are **partially aligned**

General

Diverting attention

S's signal **diverts R's attention** if:

- It provides information on the dimension where interests are misaligned
- In the absence of S's signal, R receives information on this dimension

Intuition: information is provided not to induce R's learning but to discourage information acquisition on the unfavorable dimension

Interim beliefs

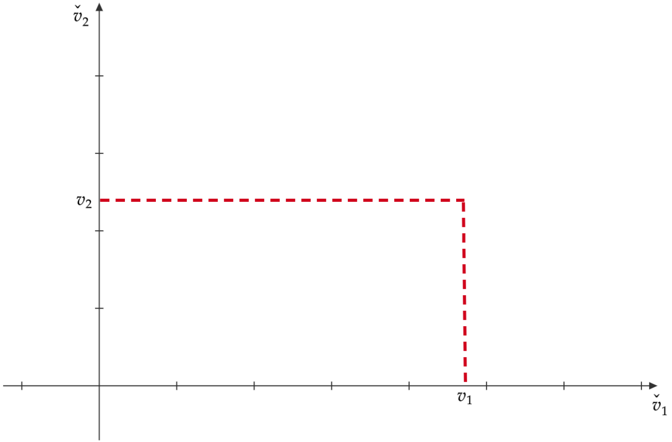


Figure: Attainable set of interim beliefs

Baseline framework

R is minimizing the remaining uncertainty + entropy costs of information acquisition:

$$\Downarrow$$

R learns the most uncertain dimension i so that $\widetilde{v}_i = \lambda/2$

Baseline framework

R is minimizing the remaining uncertainty + entropy costs of information acquisition:

$$\Downarrow$$

R learns the most uncertain dimension i so that $\widetilde{v}_i = \lambda/2$

Underlying assumption: $\lambda/2 < v_2 < v_1$

Posterior beliefs

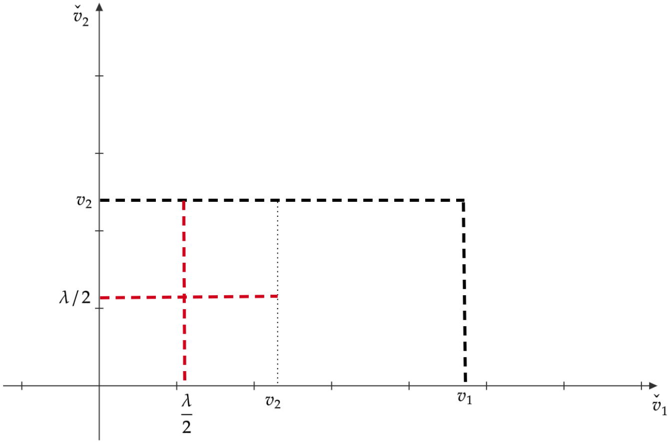


Figure: Attainable set of posterior beliefs (given R's optimal response)

Solution

$$\mathbb{E}_F[u_S(a,\theta)] = -(2\beta_1 - 1)\widetilde{v}_1 - (2\beta_2 - 1)\widetilde{v}_2$$

Case 1: $\beta_1 < 1/2$, $\beta_2 > 1/2$ (interests misaligned on the more uncertain dimension) Figure

Solution

$$\mathbb{E}_F[u_S(a,\theta)] = -(2\beta_1 - 1)\widetilde{v}_1 - (2\beta_2 - 1)\widetilde{v}_2$$

Case 1: $\beta_1 < 1/2$, $\beta_2 > 1/2$ (interests misaligned on the more uncertain dimension) Figure

$\mathbb{E}[u_S(A)] = -(2\beta_1 - 1)\lambda/2$

$\mathbb{E}[u_S(B)] = -(2\beta_1 - 1)v_2 - (2\beta_2 - 1)\lambda/2$

Solution

$$\mathbb{E}_F[u_S(a,\theta)] = -(2\beta_1 - 1)\widetilde{v}_1 - (2\beta_2 - 1)\widetilde{v}_2$$

Case 1: $\beta_1 < 1/2$, $\beta_2 > 1/2$ (interests misaligned on the more uncertain dimension) Figure

$$\mathbb{E}[u_S(A)] = -(2\beta_1 - 1)\lambda/2$$

$$\mathbb{E}[u_S(B)] = -(2\beta_1 - 1)v_2 - (2\beta_2 - 1)\lambda/2$$

$$\frac{\lambda}{2} < \frac{-(2\beta_1 - 1)}{2(\beta_2 - \beta_1)}v_2 \quad \Rightarrow \quad \mathbb{E}[u_S(B)] > \mathbb{E}[u_S(A)]$$

Solution

$$\mathbb{E}_F[u_S(a,\theta)] = -(2\beta_1 - 1)\widetilde{v}_1 - (2\beta_2 - 1)\widetilde{v}_2$$

Case 1: $\beta_1 < 1/2$, $\beta_2 > 1/2$ (interests misaligned on the more uncertain dimension) Figure

$$\mathbb{E}[u_S(A)] = -(2\beta_1 - 1)\lambda/2$$

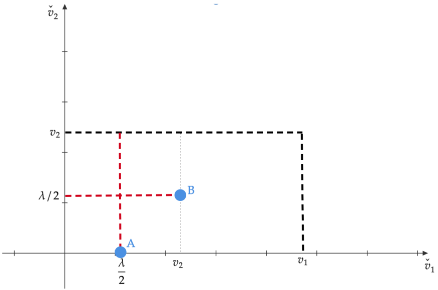
$$\mathbb{E}[u_S(B)] = -(2\beta_1 - 1)v_2 - (2\beta_2 - 1)\lambda/2$$

$$\frac{\lambda}{2} < \frac{-(2\beta_1 - 1)}{2(\beta_2 - \beta_1)} v_2 \quad \Rightarrow \quad \mathbb{E}[u_S(B)] > \mathbb{E}[u_S(A)]$$

BUT!

R is more informed in A than in B (total uncertainty) Next

Partially aligned interests

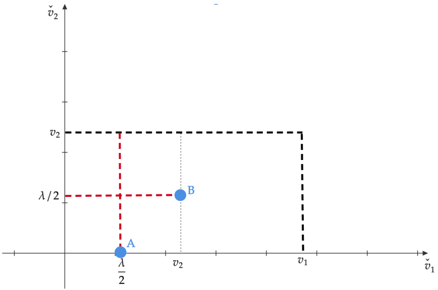


Candidate A:
$(\widetilde{v}_1, \widetilde{v}_2) = (\lambda/2, 0)$

Candidate B:
$(\widetilde{v}_1, \widetilde{v}_2) = (v_2, \lambda/2)$

Figure: Attainable set of posterior beliefs

Partially aligned interests



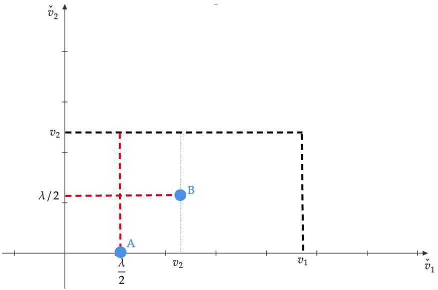
Candidate A:
$(\widetilde{v}_1, \widetilde{v}_2) = (\lambda/2, 0)$

Candidate B:
$(\widetilde{v}_1, \widetilde{v}_2) = (v_2, \lambda/2)$

Figure: Attainable set of posterior beliefs

Candidate A: S reveals information on dimension 2, R learns dimension 1

Partially aligned interests



Candidate A:
$(\widetilde{v}_1, \widetilde{v}_2) = (\lambda/2, 0)$

Candidate B:
$(\widetilde{v}_1, \widetilde{v}_2) = (v_2, \lambda/2)$

Figure: Attainable set of posterior beliefs

Candidate A: S reveals information on dimension 2, R learns dimension 1

Candidate B: S partially reveals information on dimension 1 for R to learn dimension 2 Back

Observation 1

Observation

If

- interests are partially aligned
- misalignment on the more uncertain dimension
- R well-informed (low cost of information acquisition)

then S diverts R's attention away from the dimension of misalignment

Observation 2

The solution in which S diverts R's attention might be harmful for R even if the costs of information are low:

Observation

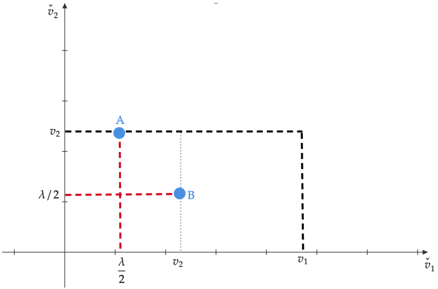
R's utility is non-monotonic in her costs of information acquisition: $\exists$ an interval $(\underline{\lambda}, \overline{\lambda})$ such that $\mathbb{E}[u_R(\lambda)] < \mathbb{E}[u_R(\overline{\lambda})]$ for all $\lambda \in (\underline{\lambda}, \overline{\lambda})$.

Negative value of information for R!

Conclusion Extensions

Misaligned interests

Assume $\beta_1 < 1/2$, $\beta_2 < 1/2$



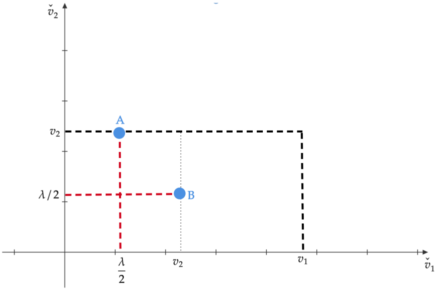
Candidate A:
$(\widetilde{v}_1, \widetilde{v}_2) = (\lambda/2, v_2)$

Candidate B:
$(\widetilde{v}_1, \widetilde{v}_2) = (v_2, \lambda/2)$

– Without S's signal: A is the solution

Misaligned interests

Assume $\beta_1 < 1/2$, $\beta_2 < 1/2$



Candidate A:
$(\widetilde{v}_1, \widetilde{v}_2) = (\lambda/2, v_2)$

Candidate B:
$(\widetilde{v}_1, \widetilde{v}_2) = (v_2, \lambda/2)$

- Without S's signal: A is the solution
- If $\beta_2 > \beta_1$ (conflict of interests stronger on dimension 1) $\Rightarrow$ S partially reveals information on dimension 1(B is the solution)

Observation 3

Observation

If

- interests are fully misaligned
- misalignment greater on the more uncertain dimension
- R well-informed (low cost of information acquisition)

then S diverts R's attention away from the dimension of higher misalignment

Extensions

– Single action for R

$$u_R(a,\theta) = -(a - (\theta_C + \theta_P))^2$$
$$u_S(a,\theta) = -(a - \theta_C)^2$$

where θ_C - common component and θ_P - private component of R

But! R can observe only θ_C, or θ_P, but not a mixture

– Arbitrary number of linear signals for R under a budget constraint

Conclusion

- We uncover a new role for information provision: to divert attention away from unfavorable issues
- We build a multidimensional Sender-Receiver framework with private information acquisition
- In such framework Sender's signals have two effects: standard information provision + diverting Receiver's attention
- In the presence of a conflict of interests, Sender diverts Receiver's attention by providing information on the dimension of (higher) misalignment of interests

Future Research

Thank you!

Observation 2

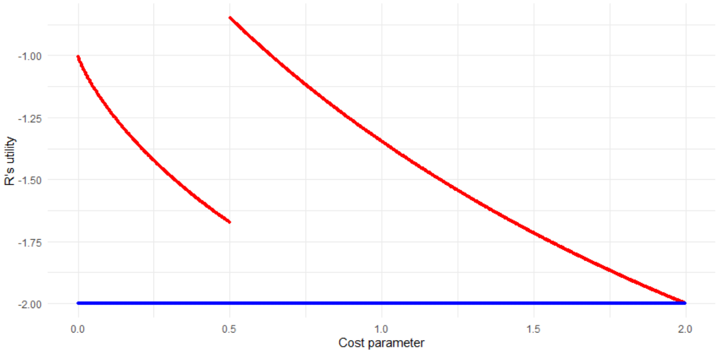


Figure: R's equilibrium utility as a function of cost parameter

Back

Future Research

- Substitutability/complementarity of signals:
  - utility?
  - cost function?
- Beyond normal distributions

Back

General

R's and S's ec-ante expected utilities can be presented as:

$$\mathbb{E}u_R(a,\theta) = -V_R^T \widetilde{\Sigma} V_R$$
$$\mathbb{E}u_S(a,\theta) = -V_S^T \widetilde{\Sigma} V_S$$

V_R and V_S determine the conflict of interests

Back