Communication, corporate governance, and organizational structure

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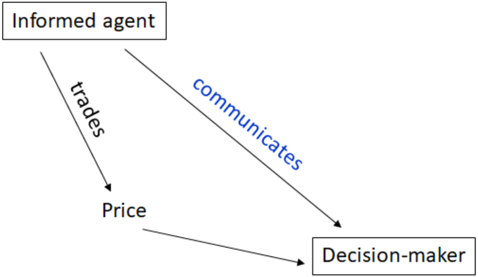
How dispersed information affects decisions

- Information is typically dispersed
  - Decision-makers are not perfectly informed
  - Other agents often know additional information
- How does this information affect decisions?



Motivation

Decision-makers often get advice from informed but biased agents

- Top executive and divisional manager
- Financial advisor advising a client on portfolio allocation
- VC and entrepreneur
- Investment banker advising a buyer or seller in M&A
- Board and CEO
- Managers and proxy advisors advising shareholders on voting
- Shareholders advising management: activists, advisory votes

Questions

- How much information can be communicated?
- How to design decision-making processes to maximize efficiency?
- How does private, unobserved communication explain observed phenomena?

Outline

1. **Cheap talk communication**
   - **Crawford and Sobel 1982**

2. Allocation of control rights
   - Dessein 2002

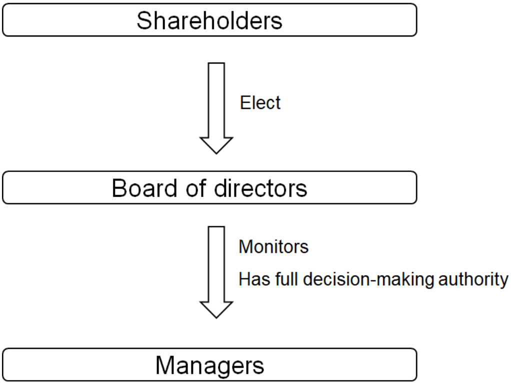
3. Corporate finance and governance applications

4. Dynamic communication
   - Grenadier, Malenko, Malenko 2016

Strategic information transmission

- When a biased agent communicates his information to the decision-maker, he has incentives to "misreport"
  - to tilt the decision-maker towards his preferred decision
- This makes communication less effective
- Questions
  - How much information can be communicated?
  - How efficient are decisions?

Example: Board and CEO



Crawford and Sobel 1982: Setup

Two players

- Sender
  - has private information θ and communicates it
  - e.g., CEO knows information about project payoff
- Receiver
  - takes action a
  - e.g., board decides how much to invest in a project

Setup: Timeline

1. S privately observes state θ
   - $\theta \sim F(\cdot)$, $f(\cdot)$ on $\left[\underline{\theta}, \bar{\theta}\right] = [0, 1]$
   - We will focus on **uniform** distribution (and **quadratic** preferences), but the paper is more general
     - other common distribution: binary
2. S sends message $m \in M$ to R
   - information is **non-verifiable**, so S can misreport
3. R chooses action $a \in \mathbb{R}$

Setup: Payoffs

$$
\begin{aligned}
U^R(a,\theta) &= -(a-\theta)^2 \\
U^S(a,\theta,b) &= -(a-(\theta+b))^2
\end{aligned}
$$

- Receiver's optimal action is θ
- Sender's optimal action is $\theta + b$
  - E.g., $b > 0$ from empire-building
  - Note: S still cares about fundamentals. Otherwise, no communication at all is possible.

Talk is "cheap": message m does not affect S's payoff

- unlike in costly signaling games (e.g., Spence on education)
  - signaling is costly but credible
  - cheap talk communication is costless but less credible

Bayes-Nash equilibrium

- Sender's message strategy $m : \left[\underline{\theta}, \bar{\theta}\right] \rightarrow M$ and
- Receiver's action strategy $a : M \rightarrow \mathbb{R}$ such tha

$$m(\theta) \in \max_{m} \; U^S(a(m), \theta, b) \qquad (1)$$

$$a(m) \in \arg\max_{a} \; \mathbb{E}[U^R(a,\theta)|m] = \mathbb{E}[\theta|m] \qquad (2)$$

$$= \arg\max_{a} \int_{\underline{\theta}}^{\bar{\theta}} U^R(a,\theta)\, p(\theta|m),$$

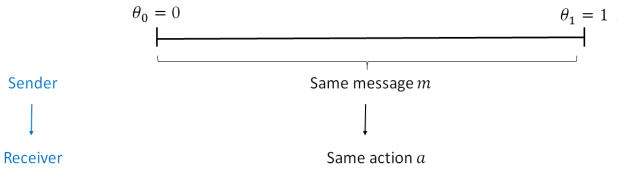
where $p(\theta|m)$ are beliefs given Bayes rule

- if $q(m|\theta)$ is prob. of m given θ, $p(\theta|m) = \frac{q(m|\theta)f(\theta)}{\int q(m|\theta)f(\theta)d\theta}$

Equilibria

1. Uninformative ("babbling") equilibrium always exists

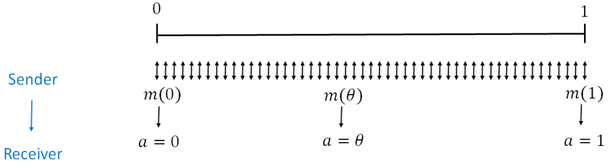
- E.g., S always sends the same message
  - many other ways to construct eqm, e.g., random messages
- R ignores messages and takes action $\mathbb{E}[\theta]$
  - given this, S is indifferent $\Rightarrow$ optimal to "babble"



Equilibria

2. Fully informative equilibrium exists only if $b = 0$

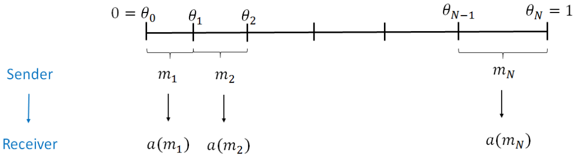
- In such eqm, $m(\theta_1) \neq m(\theta_2)$, so R knows state for sure
  - $\Rightarrow$ Given $m(\theta)$, R takes $a = \theta$
- But then, S wants to send $\tilde{m} = m(\theta + b)$



Structure of informative equilibria

3. Informative equilibria have a "partition" structure

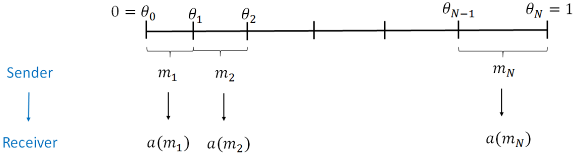
- Points $0 = \theta_0 < \theta_1 < \dots < \theta_{N-1} < \theta_N = 1$
- All S types in $[\theta_{i-1}, \theta_i]$ send the same message
    - and hence induce the same action of R



Structure of informative equilibria

- Intuition: Close types must send the same message
  - otherwise low type would mimic high type to induce a higher *a*
- Types at cutoff points are indifferent

  $\Rightarrow$ types just to the left don't mimic types just to the right



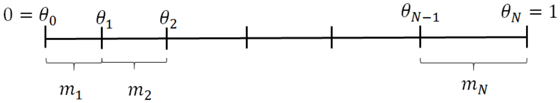
Characterizing partition equilibria

1. **Optimality for R:**

$$a_i = \mathbb{E}\left[\theta | m_i\right] = \frac{\theta_{i-1} + \theta_i}{2}$$

2. **Optimality for S (indifference of cutoff types):**

$$\left(a_i - (\theta_i + b)\right)^2 = \left(a_{i+1} - (\theta_i + b)\right)^2$$



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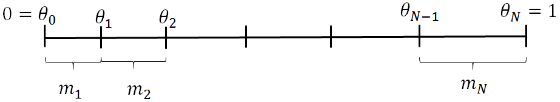
$$\left(a_i - (\theta_i + b)\right)^2 = \left(a_{i+1} - (\theta_i + b)\right)^2$$

$$\Rightarrow \theta_{i+1} - \theta_i = \theta_i - \theta_{i-1} + 4b$$

Partition size is increasingly large (by 4b)

$$\theta_{i+1} - \theta_i = \theta_i - \theta_{i-1} + 4b$$



- "Larger" messages are more noisy ⇒ exaggeration is costly ⇒ S is induced to tell the truth
  - Larger bias b ⇒ stronger incentive to exaggerate ⇒ larger increase in partition size
- "Common sense" interpretation:
  - If a person who prefers large projects recommends a "large" project, his message is not very informative
  - If he recommends a "small" project, this is more revealing

Characterizing partition equilibria

$$\theta_{i+1} - \theta_i = \theta_i - \theta_{i-1} + 4b$$

- Second-order difference equation $\Rightarrow$ using $\theta_0 = 0$, solution is

$$\theta_i = \theta_1 i + 2i\left(i-1\right)b$$

- Using $\theta_N = 1$ for a given N, we get unknown θ_1

- There are multiple equilibria with different N, as long as $2N\left(N-1\right)b < 1 \Leftrightarrow N \leq N_{\max}$

Selecting among equilibria

- There are multiple equilibria with different N for $N \leq N_{\max}$
  - $N = 1$ gives the uninformative one
  - $N = N_{\max}$ gives the **most informative** one

- Ex-ante expected utilities

$$\begin{aligned} EU^R &= -\sigma^2 \\ EU^S &= -\left(\sigma^2 + b^2\right) \end{aligned}$$

where σ^2 is residual variance; $\sigma^2 \searrow N$ for $N \leq N_{\max}$

  - S would be better off if he could commit not to lie, but cannot

- The most informative equilibrium **Pareto-dominates** all others $\Rightarrow$ typically selected

Properties of the most informative equilibrium

$$2N(N-1)b < 1 \Leftrightarrow N \leq N_{\max} = \left\langle -\frac{1}{2} + \frac{1}{2}\sqrt{1+\frac{2}{b}} \right\rangle$$

where $\langle x \rangle$ is the smallest integer greater than or equal to x

- **More aligned preferences $\Rightarrow$ more informative communication**
  - As $b \searrow$, $N_{\max}$ and expected utility of R and S $\nearrow$
  - If $b \to 0$, $N_{\max} \to \infty$: full communication
  - If $b \geq \bar{b}$ $(= \frac{1}{4})$, $N_{\max} = 1$: only babbling equilibrium

- Source of inefficiency is **information loss**
  - not bias directly, because R is the **decision-maker** and "de-biases" messages

Other models of strategic communication

1. Cheap talk: **non-verifiable** information

2. Voluntary disclosure of **verifiable** information
   - S can stay silent but cannot misreport
   - Grossman 1981; Milgrom 1981; Verrecchia 1983; Dye 1985

3. Bayesian persuasion
   - S **commits** to a mapping from states to R's signals
     - i.e., info is also verifiable, but S "designs" its distribution
   - Kamenica-Gentzkow 2011

- Different results; different applications

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2. **Allocation of control rights**
   - **Dessein 2002**
3. Corporate finance and governance applications
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Allocation of control rights

- If uninformed **principal has control** over decisions:
  - decisions are unbiased
  - but agent's information is partly lost
- What if **principal delegates control** to the agent?
  - decisions are biased
  - but agent's information is not lost
- **What is the optimal allocation of control rights?**

Applications

- Top executive and divisional manager
- Board and CEO
- VC and entrepreneur
- Financial advisor advising a client on portfolio allocation

Allocation of control: Dessein (2002)

- Consider the Crawford-Sobel (1982) setup
    - We will focus on the uniform-quadratic setup
    - Dessein's setup is more general

    - **Principal** = Receiver; **Agent** = Sender

- **When does P prefer to delegate authority to A?**

Keeping authority vs. Delegating

P keeps authority

- Partial communication with $N(b) = N_{\max}$ partitions
- P chooses $\frac{\theta_i + \theta_{i-1}}{2}$ - unbiased, but not fully informed
- P's expected utility $= -$ residual variance, or

$$\mathbb{E}_{keep}[U^P] = -\frac{1}{12N(b)^2} - \frac{1}{3}b^2\left(N(b)^2 - 1\right)$$

P delegates authority to A

- A chooses $a_A = \theta + b$ - informed but biased
- P's expected utility is $-\mathbb{E}(a_A - \theta)^2$:

$$\mathbb{E}_{delegate}[U^P] = -b^2$$

Key takeaways

Trade-off:

Delegate $\Rightarrow$ loss of control (biased decision)

vs.

Keep authority $\Rightarrow$ loss of information (less informed but unbiased decision)

Key takeaways (cont.)

- **As bias b increases, P is worse off in both regimes**
  - Communication is worse, so $\mathbb{E}_{keep}[U^P]$ decreases
  - A's decisions are more biased, so $\mathbb{E}_{delegate}[U^P]$ also decreases

- **When bias b is large, delegation is inferior**
  - P's loss from delegation is unlimited
  - P's loss from keeping authority is limited: the worst is an uninformed decision based on priors

Comparison for small biases

- When bias is large, delegation is inferior
- As bias decreases, both regimes give P higher payoff
- Which dominates when bias b is small?

- Dessein's result: **Delegation is superior when b is small**
  - uniform-quadratic setup:
    - delegation $\Rightarrow$ P's loss is second-order in b
    - communication $\Rightarrow$ P's loss is first-order in b
  - shows this also holds for some more general setups

Predictions

- Dessein's predictions: Delegation is more likely when
  1. Agent's information advantage is large relative to his bias
  2. Principal is more risk-averse
     - unbiased actions with large variance under P's authority

- Large theoretical literature, but scarce empirical evidence
  - Organizational economics: determinants of decentralization
    - Acemoglu et al. 2007; Bloom et al. 2014; Huang et al. 2017; Dessein et al. 2018
  - Finance settings: VC contracts, board control

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Some finance applications

- **Financial markets**
  - Benabou-Laroque 1992: informed agent 1) manipulates prices through public messages, 2) trades before or after
- **Financial analysts**
  - Ottaviani-Sorensen 2006: unbiased sender, cares about his reputation for ability
- **Mergers and acquisitions; auctions**
  - Levit 2017: board advises target shareholders whether to accept a takeover offer
  - Quint-Hendriks 2018: nonbinding bids prior to binding
  - Malenko-Tsoy 2019: auction design when bidders learn their private valuations from biased advisors (investment bank/CEO)
- **Corporate governance**
  - board-CEO relationships; shareholder activism; voting

Application of Dessein 2002 to board-CEO

- Board = Principal
  - by law, has full decision-making authority
- CEO = Agent
  - better informed but biased
- **Implication**: Board should delegate decisions for which CEO's information is large relative to his bias

- Does the board have commitment power to delegate?
  - e.g., irreversible or very costly to reverse decisions
  - across decisions: through weaker governance
    - dual class shares; less independent board; CEO-chairman

What is unique to board-CEO relationships?

1. **Advisory role is important**
   - industry executives, finance experts, lawyers, academics
   - Hence P is also informed
     - two-sided private information
     - Adams-Ferreira 2007; Chakraborty-Yilmaz 2017; Harris-Raviv 2005, 2008, 2010; Kakhbod-Loginova-Malenko-Malenko 2019

2. **Dual advisory and monitoring roles**
   - Board advises CEO, but also interferes with his decisions
   - How do the two roles interact?
     - Adams-Ferreira 2007; Levit 2018

Harris-Raviv 2008: Two-sided private information

- Outside directors and Manager/insiders

$$U_O = -\left(a - \theta\right)^2$$
$$U_M = -\left(a - (\theta + b)\right)^2$$

and

$$\theta = \theta_O + \theta_M$$

where $\theta_O \sim U\left[0, A_O\right]$ and $\theta_M \sim U\left[0, A_M\right]$ are independent

  - A_O, A_M measure importance of each player's information

- Outsider control vs. Manager control
  - party with control gets advice from party without control

Two-sided private information

- Outsider control: O's action after getting message m is

$$a_O^* = \theta_O + \mathbb{E}\left[\theta_M | m\right]$$

- But then for M:

$$a_O^* - (\theta + b) = \mathbb{E}\left[\theta_M | m\right] - \theta_M - b$$

  which is the same as without O's private information
    - M can perfectly predict the effect of his messages on his utility
    - hence we can solve the standard Crawford-Sobel setup

- Generally: similar trade-off between info loss and biased decisions
    - delegation is more likely when Manager's info is important relative to his bias and Outsiders' info
        - e.g., dual class shares in high-tech firms

Private information of the board

- Main difference due to two-sided private information:
  - Outsiders can use their info to decide whether to delegate
  - i.e., allocation of control becomes state-contingent
- **Result**: If $b > 0$, outsiders delegate control to M iff $\theta_O > \bar{\theta}$
  - i.e., delegation is more likely when O's private information is consistent with M's bias
  - Reason: when O communicate to M, partitions are smaller when θ_O is large $\Rightarrow$ less information is lost for large θ_O $\Rightarrow$ loss from delegation is lower

Private information of the board

- Harris-Raviv 2005, 2008, 2010: take conflict of interest b as given
  - Ask: Given b, should board delegate decisions?
- Adams-Ferreira 2007; Chakraborty-Yilmaz 2017; Malenko 2014:
  - Ask: What is the optimal board composition, i.e., b?
- Key takeaway: **Less independent boards can be optimal**
  - to improve communication between boards and managers
  - to use managers' information better

Dual advisory and monitoring role

- Adams-Ferreira (JF 2007); Levit (JF forthcoming):
  - Advising = communicating to M, with M choosing *a*
  - Monitoring = affecting *a*, fully or partially

Conclusions: **These two roles conflict**, for two very different reasons:

- Adams-Ferreira: Board's info relies on M giving info to the board
  - M will not give info because of monitoring
  - Implications: friendly boards; two-tier boards
- Levit: advising $\longrightarrow$ M takes action $\longrightarrow$ costly intervention by board
  - Communication is less informative if intervention is possible

Levit (2018): Setup

Timing

1. P observes $\theta \sim U\left[\underline{\theta}, \bar{\theta}\right]$ and sends message m
2. A chooses project size $a \in \mathbb{R}$
3. P decides how much to **intervene**, Δ at cost $\delta C\left(\Delta\right)$
    - final project size is $a - \Delta$

We will focus on quadratic preferences and cost $\delta\Delta^2$

- $U_P = -\left(a - \theta\right)^2, U_A = -\left(a - \left(\theta + b\right)\right)^2$
- but results are more general

Analysis: Intervention stage

- After A chooses a, P chooses Δ to maximize

$$-(a - \Delta - \theta)^2 - \delta\Delta^2$$

$\Rightarrow$ P chooses $\Delta^* = \frac{a-\theta}{1+\delta}$

- if $\delta > 0$, P does not fully "undo" the agent's bias

Analysis: Communication stage

Anticipating $\Delta^*(a) = \frac{a-\theta}{1+\delta}$, at the communication stage:

- P maximizes

$$-\left(a - \Delta^* - \theta\right)^2 - \delta\Delta^{*2}$$

- P's ideal action is $a_P = \theta$
  - maximizes his utility from the action
  - minimizes his costs of intervention

Analysis: Communication stage

Anticipating $\Delta^*(a) = \frac{a-\theta}{1+\delta}$, at the communication stage:

- A maximizes
$$-\left(a - \Delta^* - (\theta + b)\right)^2$$
- A's ideal action satisfies $a_A = \theta + b + \Delta^*(a_A) \Rightarrow$
$$a_A = (\theta + b) + \frac{b}{\delta}$$
  - A's ideal action "overshoots" relative to the action that is eventually implemented

Analysis: Communication stage

- P's ideal action is θ
- A's ideal action is $(\theta + b) + \frac{b}{\delta}$

- Since "effective" bias exceeds b, communication is worse
  - this negative effect is strongest when δ is small or b is large
- Intuition:
  - A expects intervention $\Rightarrow$ deliberately "overshoots" as if his bias is larger $\Rightarrow$ P has even stronger incentives to understate fundamentals

- This negative effect of intervention can dominate
  - P can be better off without the power to intervene

Other governance applications

Shareholder activism

- Levit (JF forthcoming)
- Levit (RFS 2019): effect of public campaigns and exit on communication

Shareholder voting

- Voting on many issues is non-binding and hence, effectively, is similar to communication
  - Levit-Malenko (JF 2011), Kakhbod-Loginova-Malenko-Malenko (2019): multiple senders
- Proxy advisors' recommendations to shareholders
  - Levit-Tsoy (2019): multiple receivers & uncertainty about S's bias
  - Ma-Xiong (2019): Bayesian persuasion

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   - Bizzotto et al 2018; Ely 2017; Ely-Szydlowski 2017; Orlov et al 2018

Role of commitment

We have assumed **limited commitment** by the Principal

- Dessein: **P can commit not to overrule A** when giving authority
- But **P cannot commit how he reacts to A's messages**
  - otherwise would be better off
- Contracts are incomplete, hence allocation of authority matters

Limited commitment by Principal

- P cannot commit how he reacts to A's messages
  - action $a(m)$ is *ex-post optimal* for P

- Otherwise, mechanism design approach and revelation principle
  - P commits to actions as a function of A's messages; all information is truthfully reported
  - Optimal mechanism can be implemented via *constrained delegation*: A picks from a restricted "delegation set"
    - Dessein 2002: unconstrained delegation
  - E.g. Holmström 1984; Melumad-Shibano 1991; Alonso-Matouschek 2008; Amador-Bagwell 2013

- As we will see, time can indirectly give P this commitment power

Grenadier, Malenko, Malenko (2016)

Motivation

- Most decisions are not purely static:
  - many decisions are about **timing**: bringing a new product, shutting down a plant, drilling an oil well
  - most decisions can be delayed

Questions

- How do firms make timing decisions?
  - How does information flow from lower to upper levels?
  - What decisions should be delegated?

Preview of results

Timing decisions have different economics from static decisions:

- Asymmetry between "delay bias" and "early exercise bias"
  - E.g., shutting down a plant vs. product launch
  - Reason: Irreversibility of time
- Delay bias:
  1. Often full communication of information, but too late
  2. Irreversibility of time gives commitment power
  3. Delegation never helps
- Early exercise bias:
  1. Noisy communication
  2. Delegation helps if the bias is low

Simple example

- P decides on **timing** t of taking an action
  - time moves continuously from 0; no discounting
  - general setting: call option exercise

- Optimal timing depends on parameter $\theta \sim U[1,2]$

$$\begin{aligned} U^P(t,\theta) &= -(t-\theta)^2 \\ U^A(t,\theta,b) &= -(t-(\theta+b))^2 \end{aligned}$$

P's optimal timing: θ
A's optimal timing: $\theta + b$

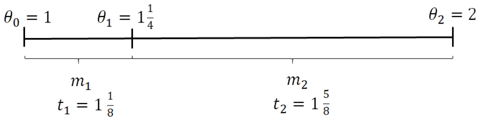
  - $b < 0$: bias towards earlier exercise (e.g., product launch)
  - $b > 0$: bias towards later exercise (e.g., plant closure)

Comparing static and dynamic communication

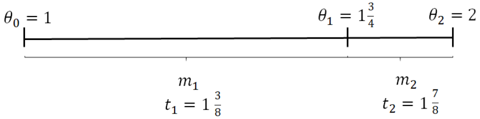
1. **Static**: A only communicates to P at $t = 0$
   - identical to Crawford-Sobel
   - **direction of the bias does not matter**
2. **Dynamic**: A communicates to P continuously
   - **direction of the bias is crucial**

Static communication

- A sends a single message at $t = 0$; P decides when to exercise
- Most informative equilibrium:
  1. $b = \frac{1}{8}$ (late exercise bias)



  2. $b = -\frac{1}{8}$ (early exercise bias)



Dynamic communication: Timing

Heuristic timing of events over $[t, t + dt]$:

1. A decides on message m_t to send to P
2. P decides whether to exercise or not
   - If P exercises, the game ends, and players receive payoffs
   - Otherwise, the game continues

Dynamic communication: Late exercise bias

Consider **late exercise bias**: $b = \frac{1}{8} > 0$

- A's optimal timing is $t_A^* = \theta + b$

Cutoff equilibrium:

- A sends message $m = 0$ ("wait") while $t < t_A^*$
  and message $m = 1$ ("exercise") once $t \geq t_A^*$

- P **follows recommendation** until $\tau^* = 2 - b$
  - if gets $m = 0$ ("wait"), waits
  - if gets $m = 1$ ("exercise"), exercises

- P exercises at $\tau^* = 2 - b$ if A still recommends to wait

Late exercise bias: Why is this equilibrium?

P: After getting the message to "exercise"

- If P gets the first message to "exercise" at t, infers $\theta = t - b$
- But his optimal timing to exercise has already passed
  $\Rightarrow$ finds it optimal to exercise
- Ideally, would have "gone back in time" and exercised at $t - b$, but cannot
- P cannot "de-bias" A's messages $\Rightarrow$ follows them
  - In a static problem, "de-biasing" always occurs

Late exercise bias: Why is this equilibrium?

P: Before getting the message to "exercise"

- P trades off waiting for information vs. delay
- At time t, P knows that $t < \theta + b \Leftrightarrow \theta > t - b$
- At first, it is optimal to wait, to get more info from A
- But as time goes by, value of waiting for A's info declines
  - So at some point, P exercises

Late exercise bias: Why is this equilibrium?

P: Before getting the message to "exercise"

- P knows that $\theta > t - b$
- Strategy: P waits until τ and then exercises
  - $\theta < \tau - b$: A will recommend to exercise at $\theta + b < \tau$, resulting in P's loss of b^2
  - $\theta > \tau - b$: P will exercise at τ, resulting in P's loss of $(\tau - \theta)^2$

$$\begin{aligned} \tau^* &= \arg\min_{\tau} \frac{1}{2-(t-b)} \left(\int_{t-b}^{\tau-b} b^2 d\theta + \int_{\tau-b}^{2} (\tau-\theta)^2 d\theta \right) \\ &= 2 - b \end{aligned}$$

Late exercise bias: Why is this equilibrium?

A: Why it is optimal to recommend exercise at $t_A^* = \theta + b$

- If $\theta < \tau^* - b$, gets his most preferred timing
  - information is fully revealed for these types
  - but timing is delayed relative to P's optimum

- If $\theta > \tau^* - b$, would like to delay beyond τ^*, but cannot benefit from deviating since P does not delay beyond τ^*

Dynamic communication: Early exercise bias

Consider **early exercise bias**: $b = -\frac{1}{8}$

- A's optimal timing is $t_A^* = \theta - \frac{1}{8}$

A similar equilibrium does not exist:

- Suppose A recommends to "wait" until t_A^*, and recommends to "exercise" at t_A^*
- If P gets the first message to "exercise" at t, infers $\theta = t + \frac{1}{8}$
- Then P optimally exercises at $t + \frac{1}{8}$
- But then A has incentives to recommend earlier exercise

In a general setting, show that all equilibria have a partition structure

Takeaways

- With a late exercise bias, P follows A's recommendations
  - time gives P commitment power not to overrule A
  - commitment power makes communication efficient
- With an early exercise bias, time does not give commitment
- Implications for optimal allocation of control
  - Delegation is less valuable under late exercise bias
  - Direction of the bias is crucial for optimal allocation of control

Implications for allocation of control

Grenadier-Malenko-Malenko (2016) show in a more general setup:

1. Communication equilibrium **implements the optimal mechanism** with commitment when A is biased towards **late** exercise
   - but not when A is biased towards early exercise

2. Hence, **delegation is never superior** to centralization under **late** exercise bias
   - Decisions like plant closures should never be delegated

3. But delegation is optimal if bias is small under **early** exercise bias
   - Decisions like product launches should be delegated if the agent's bias is small enough

Conclusions

- Relevant information is often dispersed. Decision-makers get advice from informed but biased parties.
- Conflicts of interest limit effective communication and thus hinder efficiency.
- Allocation of control crucially affects how informative and unbiased decisions are.