Misinformation Regulation in the Presence of Competition between Social Media Platforms

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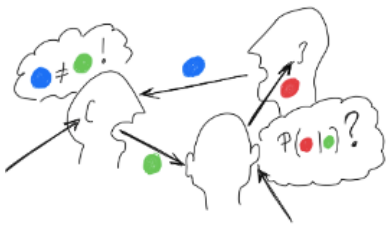

Multimodal
Network
Information
Dynamics

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- Facebook: Respects free speech [2]

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What are the underlying economic incentives for various regulations and reasonings?

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Observations

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Incentives for platforms:

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Effectiveness: Too strict regulation may be ineffective because users can move to another platform and continue harmful activities [2]

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Observations

Incentives for platforms:	Less strict regulation can be a competitive advantage [1]
Effectiveness:	Too strict regulation may be ineffective because users can move to another platform and continue harmful activities [2]
Regulation on influencers:	Regulation may depend on the power balance between platforms and influencers [3,4]

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- Mainstream platform can enforce regulation without losing users.
- Effective regulation depends on network structures and supporters of an influencer.

Precursory model 1) Contagion (e.g., S. Morris “Contagion” Review of Econ Studies 2000)

Consider technologies with positive externality (e.g., Fax, Email, Social media)

How does the new technology replace the old one?

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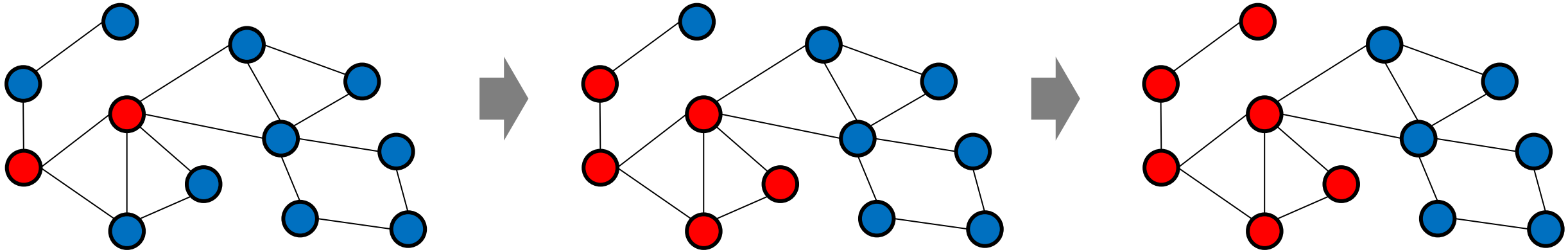
Initial state

(adopting process)

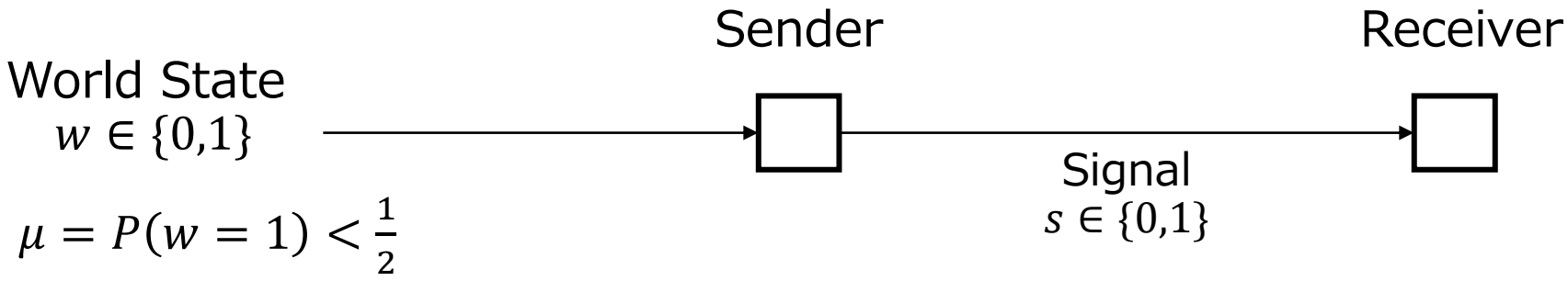
Equilibrium



Blue: Old technology

Red: New technology

Precursory model 2) Bayesian Persuasion (Kamenica and Gentzkow, American Econ Review 2011)



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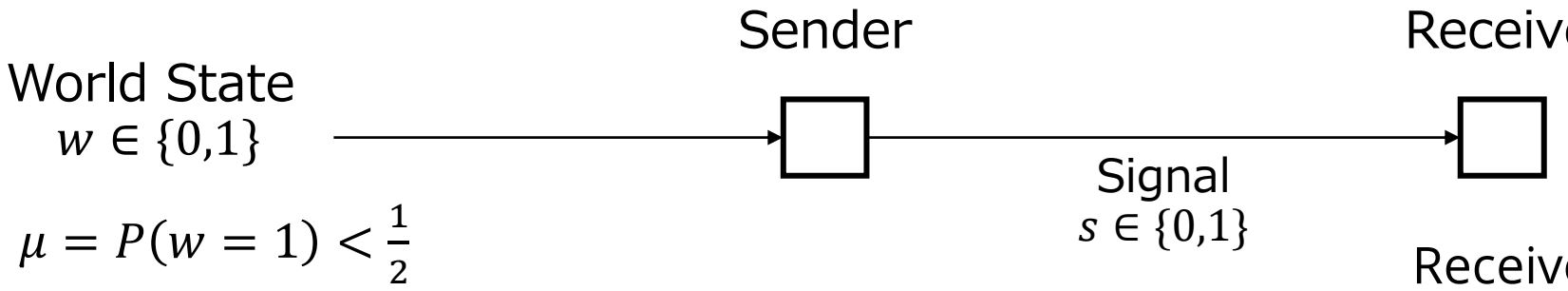
Receiver wants to estimate the world state correctly.

Sender wants Receiver to estimate world state $w = 1$.



Receiver's payoff

	$w = 0$	$w = 1$
$\hat{w} = 0$	c	0
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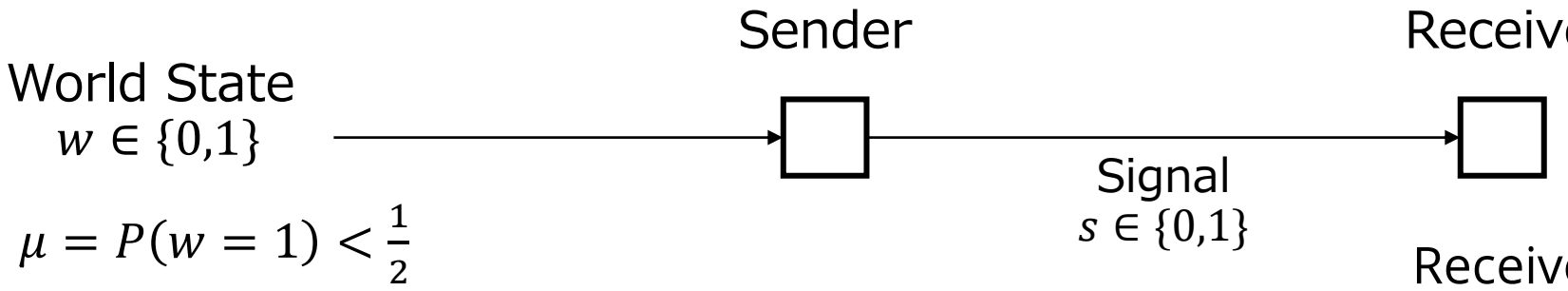

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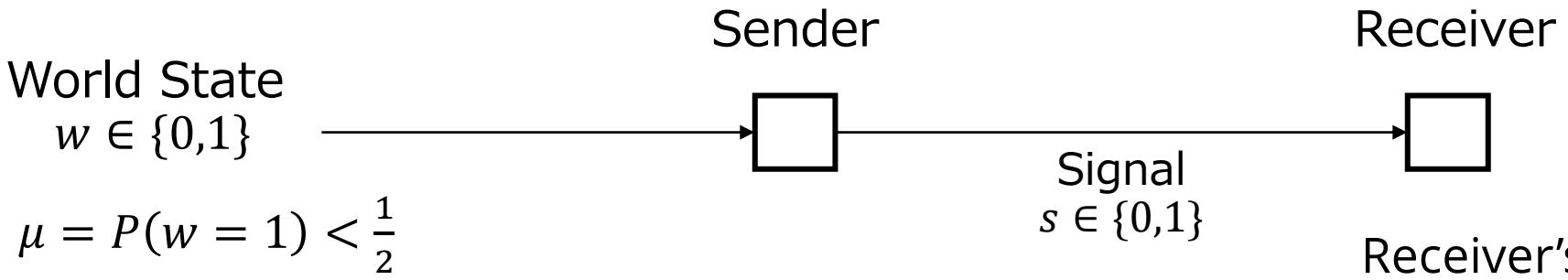

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Receiver sees β and then chooses whether they should believe the signal or not.

(Receiver doesn't know if the signal is true or not, but they can roughly assess the news source's deceitfulness or bias β by the past record or reputation.)

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- Influencer can abuse the power to distort the users' belief.
- To do so, the influencer has to be trusted and listened to.

Model

A sender and users choose platform A or B.

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User i's utility in Platform $J \in \{A, B\}$:

$$V_{iJ} = \Phi_{iJ} + \Psi_{iJ}$$

Social interaction payoff Φ_{iJ}

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Social interaction quality in Platform J

#Neighbors in Platform J

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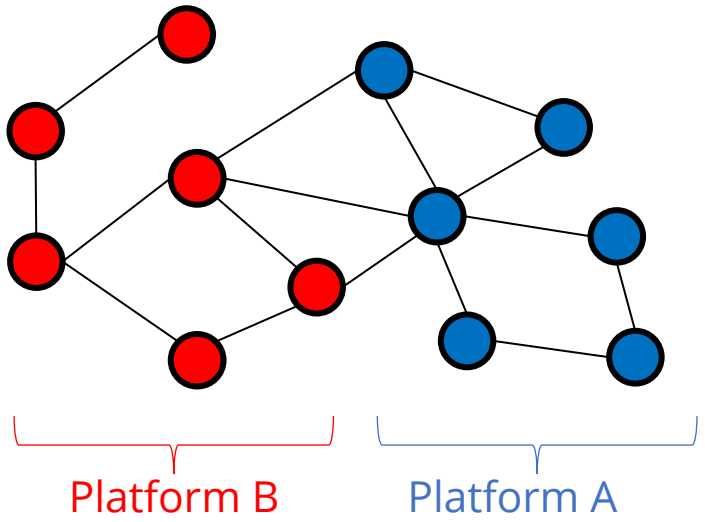

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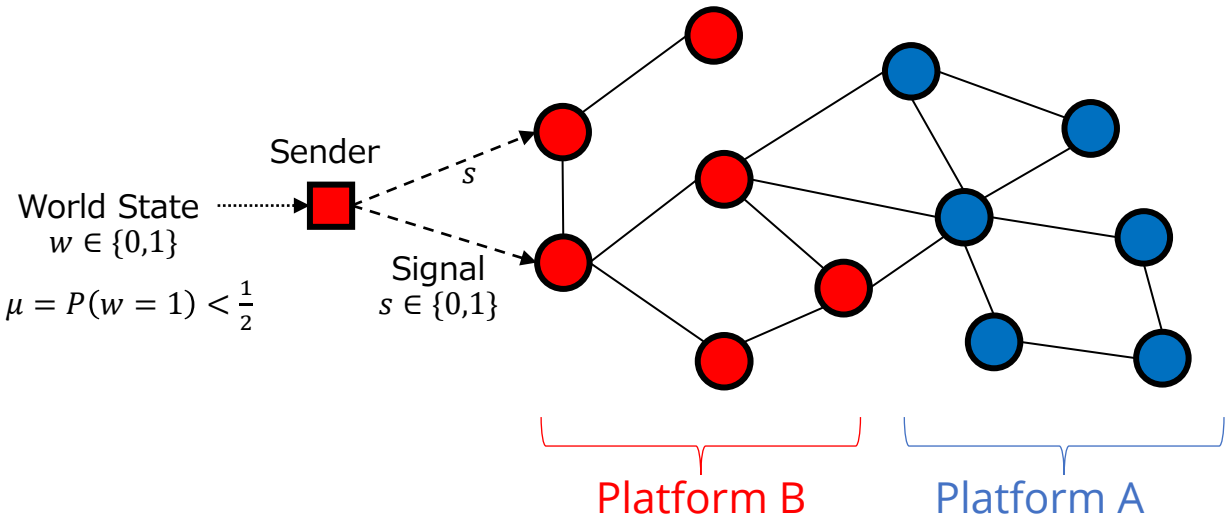

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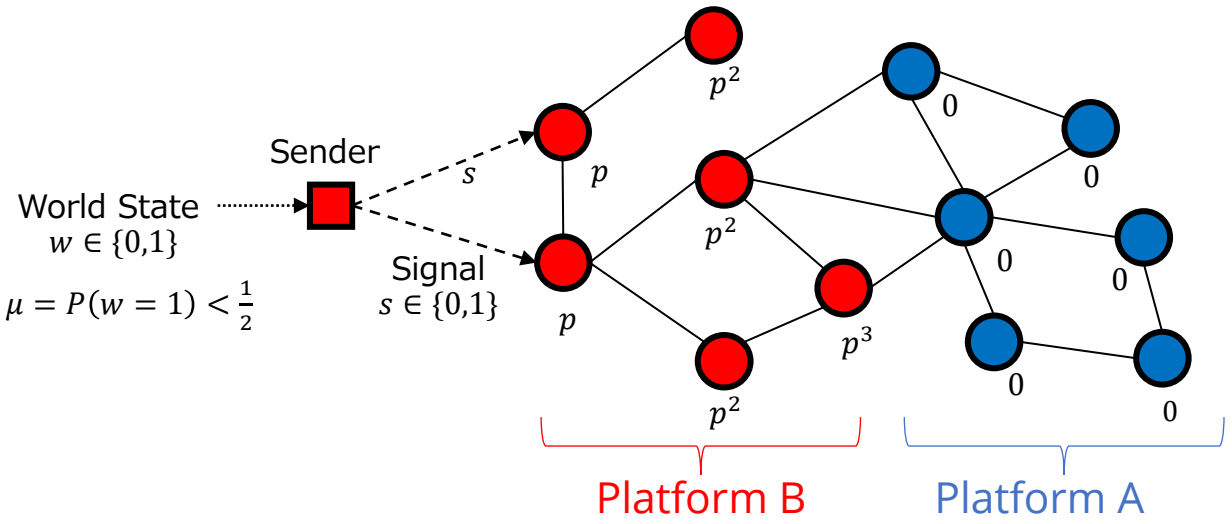

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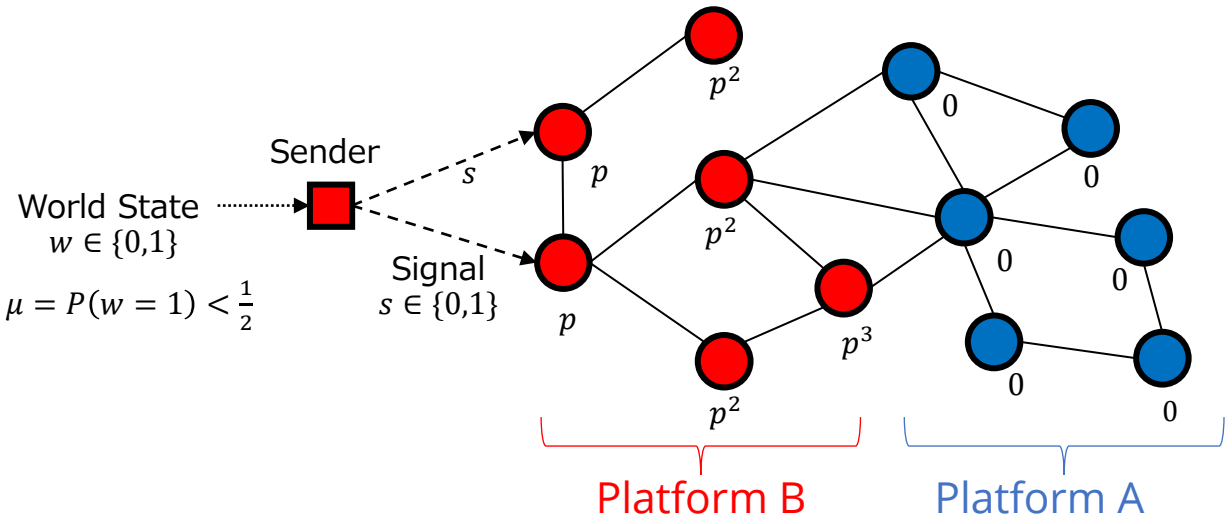

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$$\Psi_{iJ} = \begin{cases} (1-\mu)c + \{\mu(1-c) - (1-\mu)c\beta\}p_{iJ} & \text{if } \beta \le \beta' := \frac{\mu(1-c)}{(1-\mu)c} \\ (1-\mu)c & \text{otherwise.} \end{cases}$$

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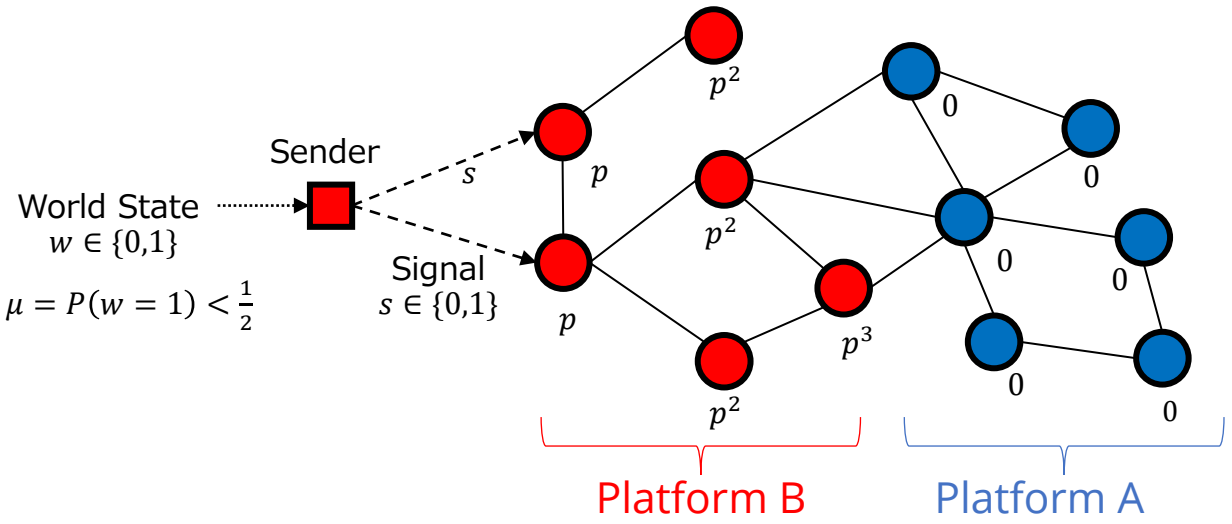

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Sender's utility: #users who estimate $\hat{w} = 1$.

$$U = \begin{cases} \sum_i (\mu + (1-\mu)\beta) p_{iJ_i} & \text{if } \beta \leq \beta'. \\ 0 & \text{otherwise.} \end{cases}$$

Probability of successful persuasion

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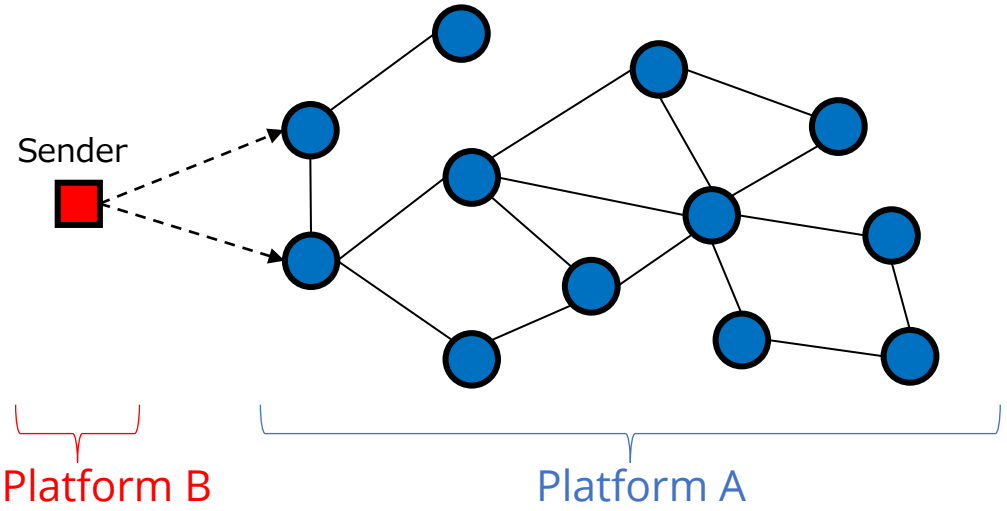
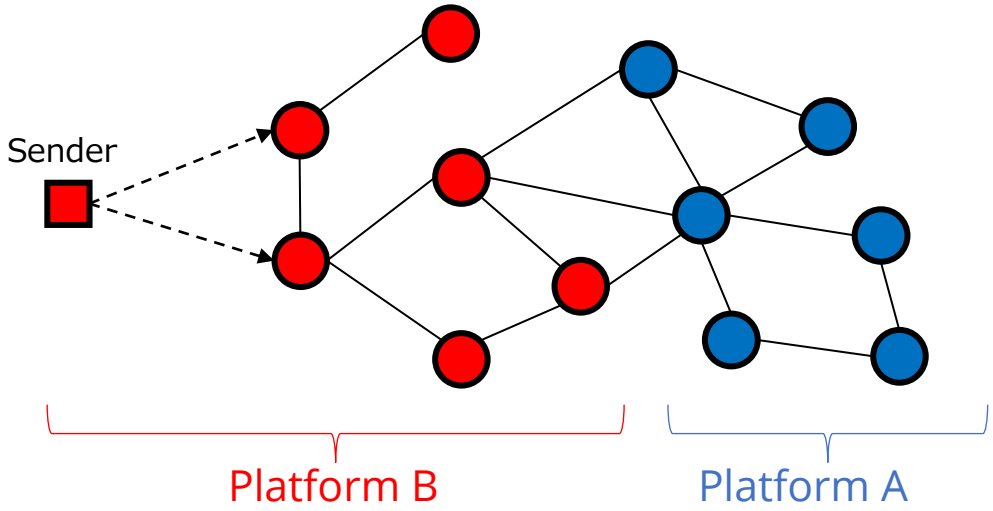
Initial state (all users in dominant Platform A)



Equilibrium



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3. Based on this equilibrium, Sender gets his utility U.

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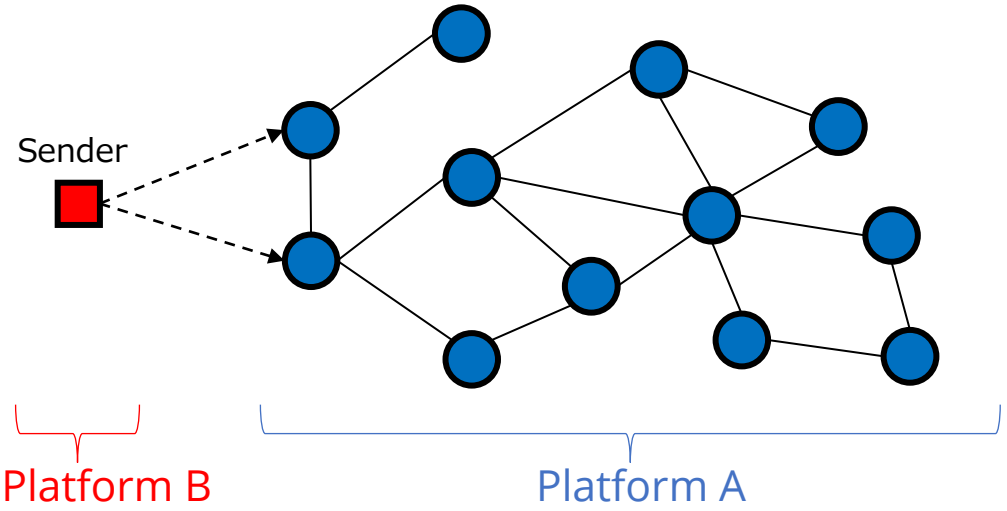

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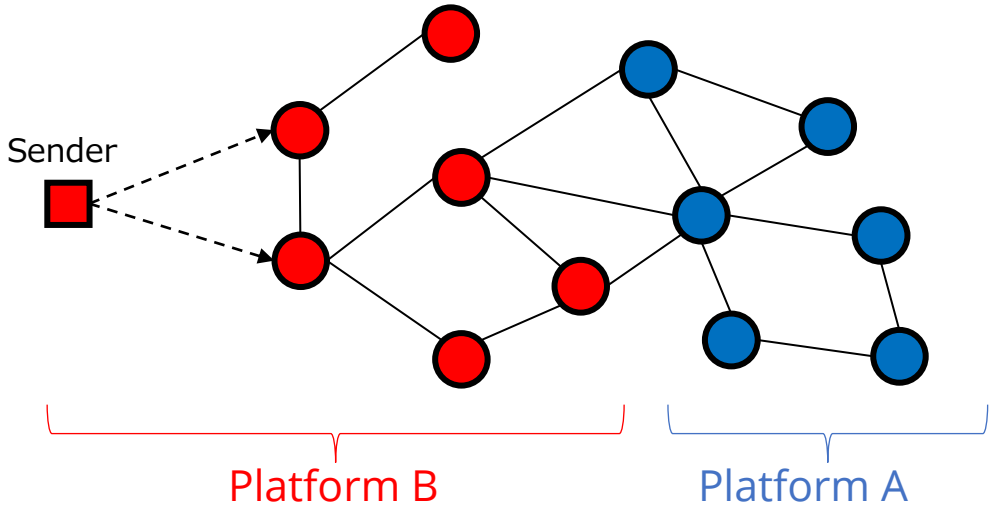

Result

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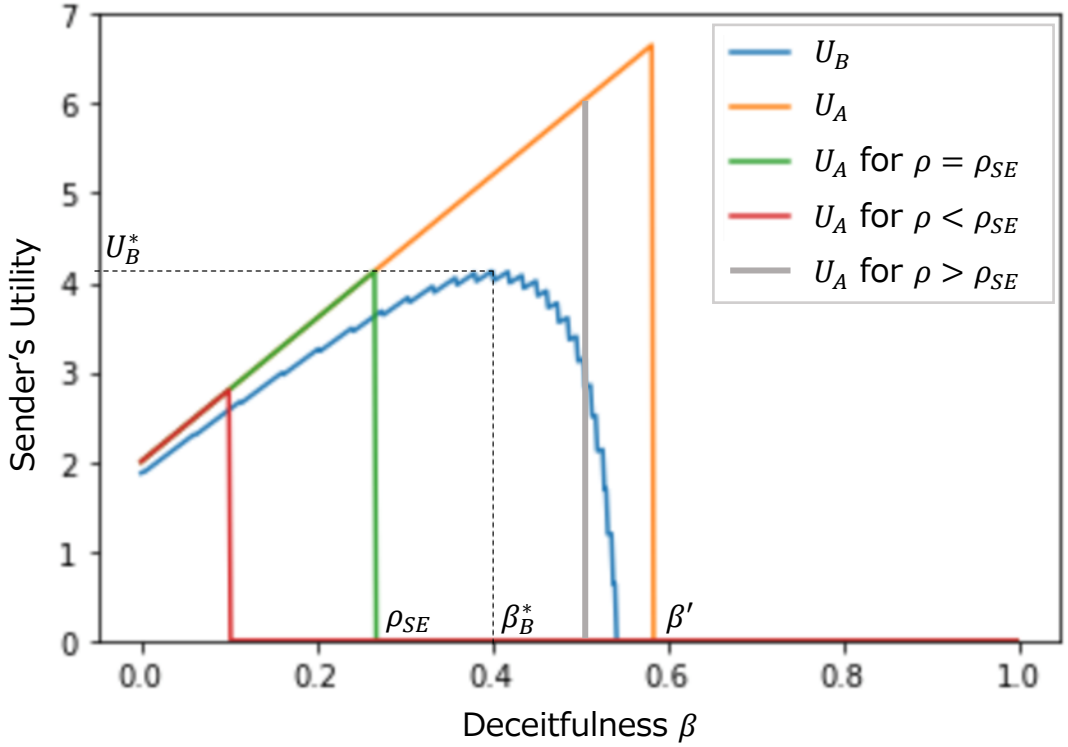

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- If Sender chooses Platform A, his utility increases monotonically with respect to β as long as $\beta \leq \beta'$.
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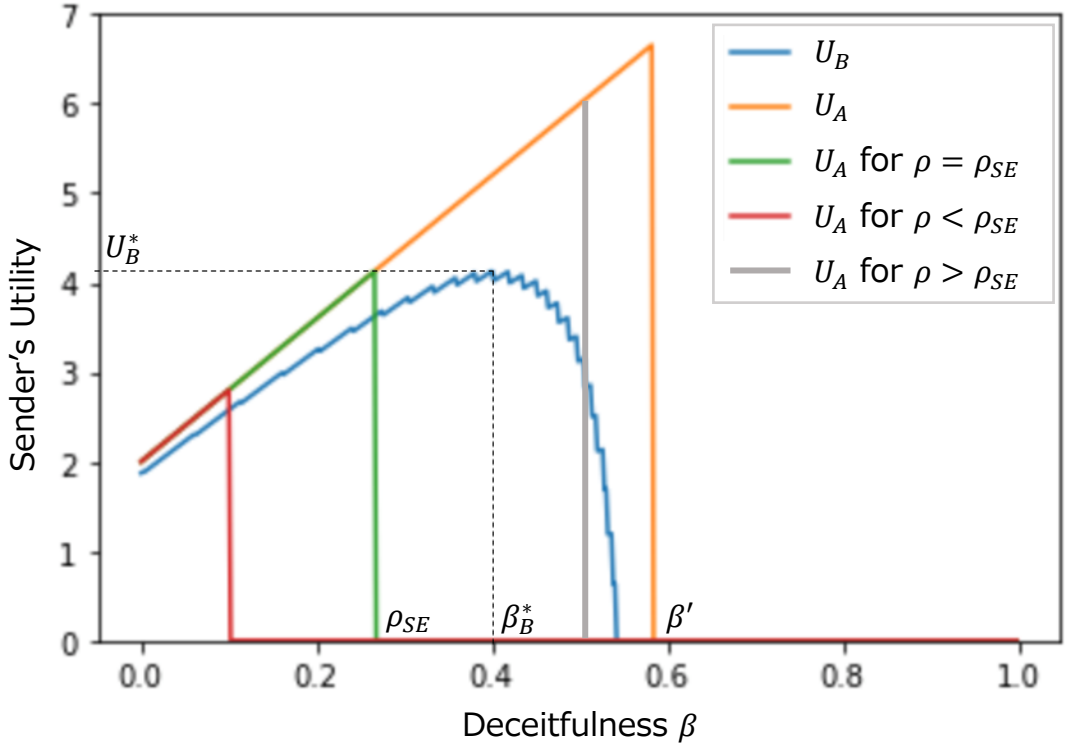

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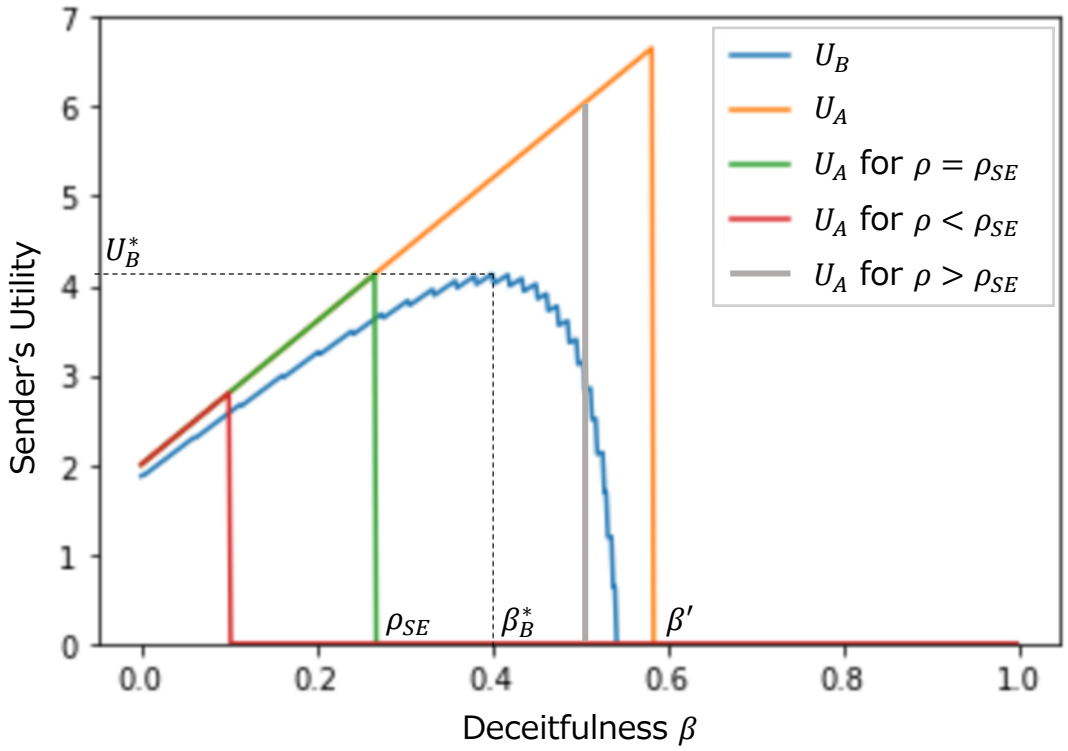
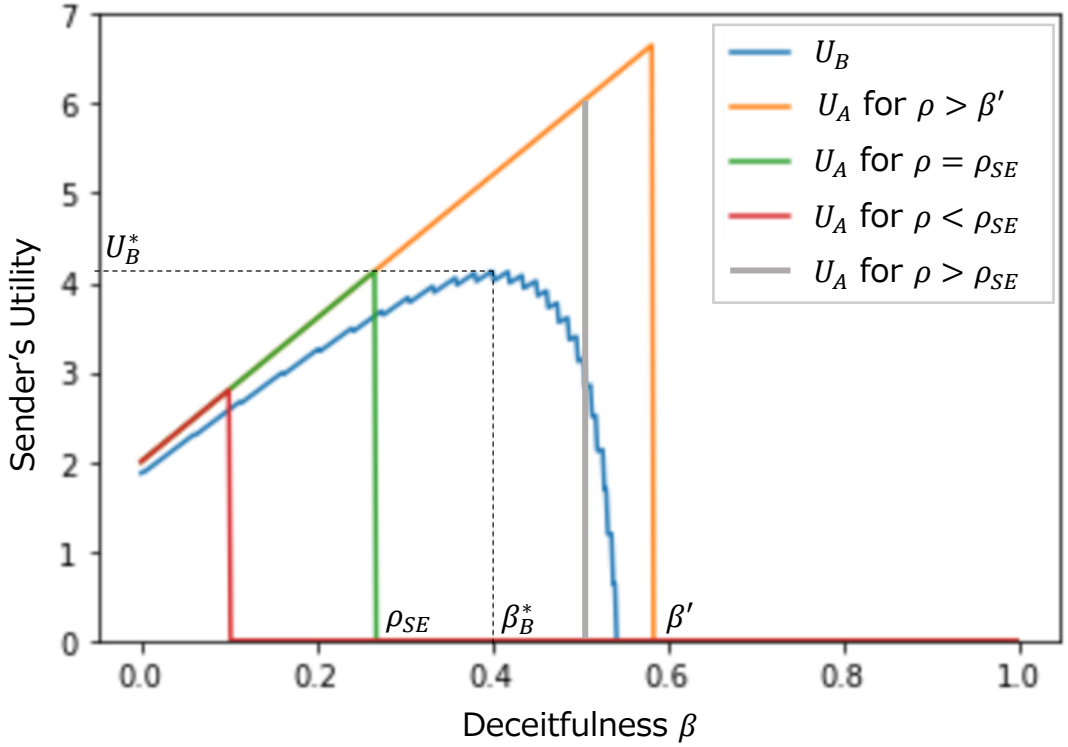


As a result, Sender gets higher utility in the initially dominant platform A.

Result

Consider regulation ρ in the popular platform A
(In Platform A, Sender chooses strategy $\beta \in [0, \boldsymbol{\rho}]$.)



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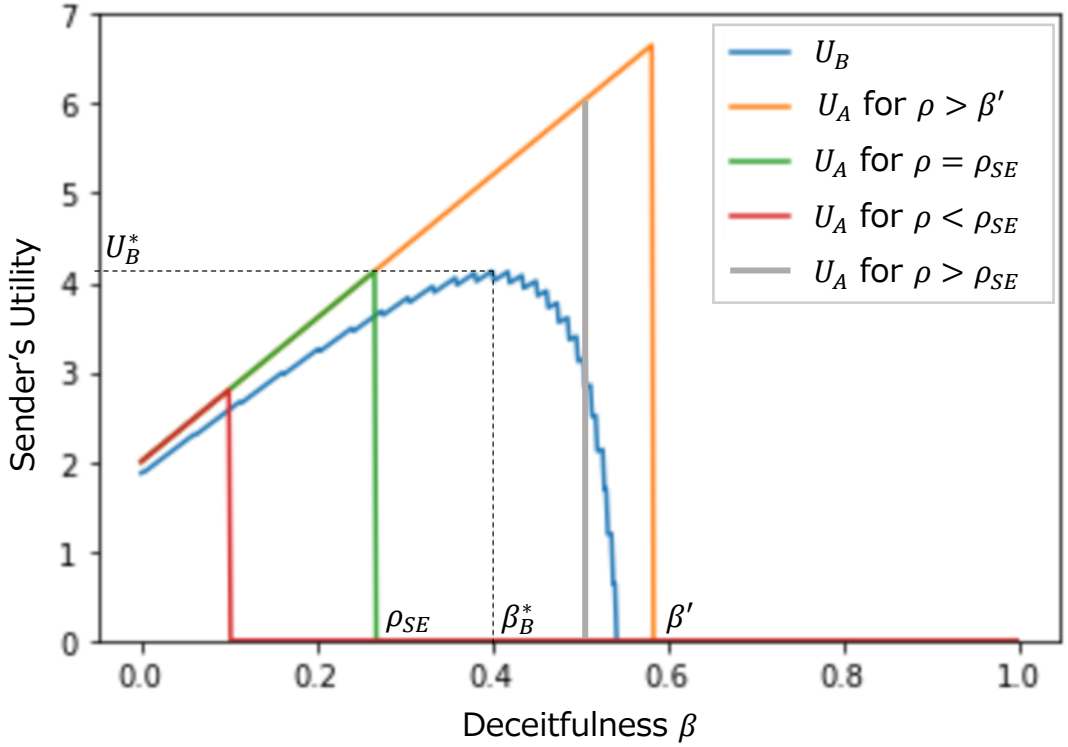
- With lenient regulation, the currently popular platform can keep all users, but the sender remains relatively deceitful.



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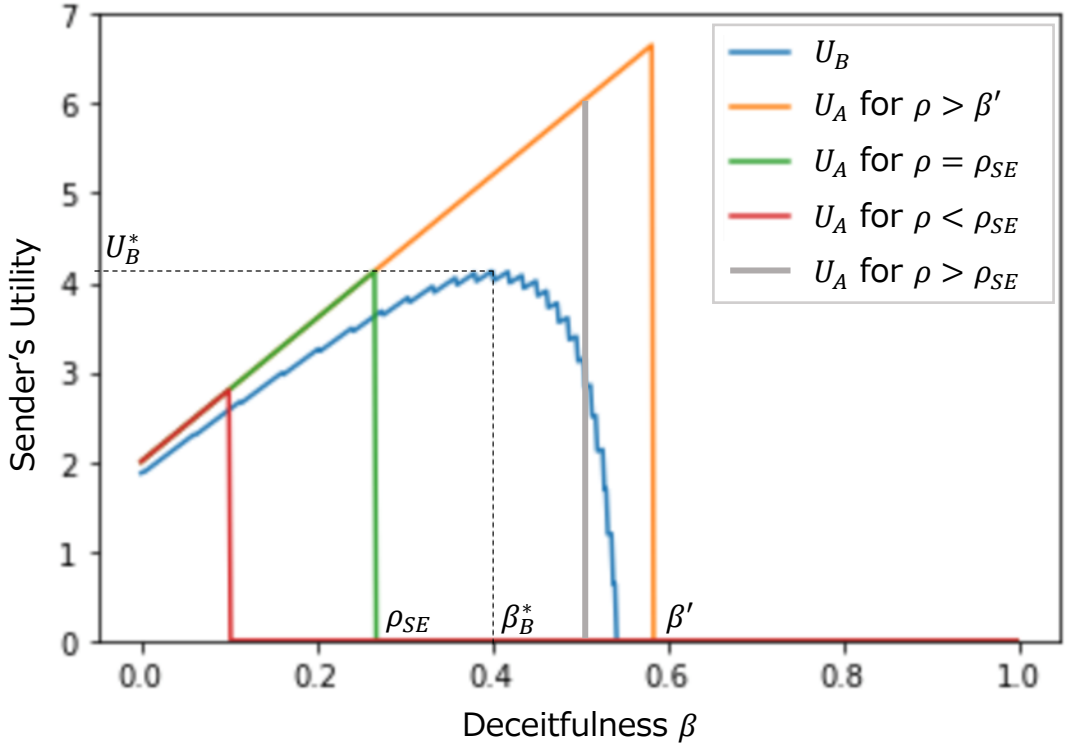
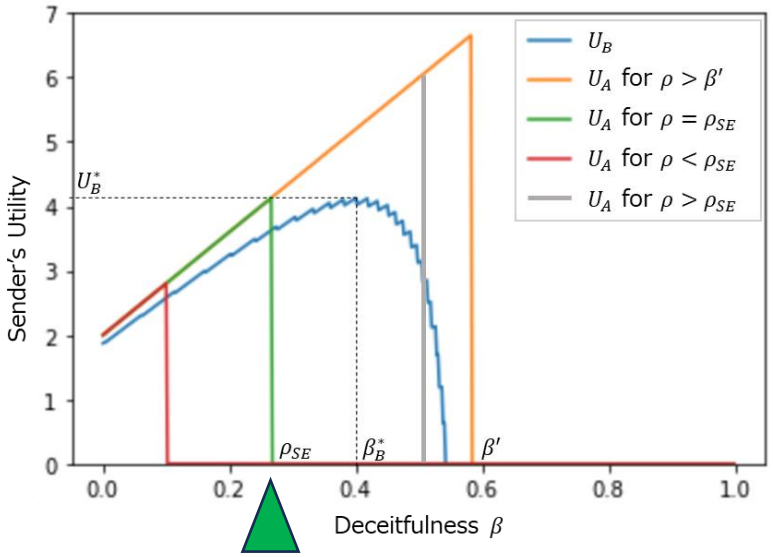


Theorem 1 (Strictest effective regulation ρ_{SE})
If $U_A(0) > U_B^*$, platform A can enforce any strict regulation effectively, i.e., $\rho_{SE} = 0$.
If $U_A(0) \leq U_B^* < U_A(\beta')$, regulation should be moderate and

$$\rho_{SE} = \frac{1}{1-\mu}\left(\frac{U_B^*}{\sum_i p_{iA}} - \mu\right).$$

If $U_A(\beta') \leq U_B^*$, then ρ_{SE} does not exist.

Recap so far



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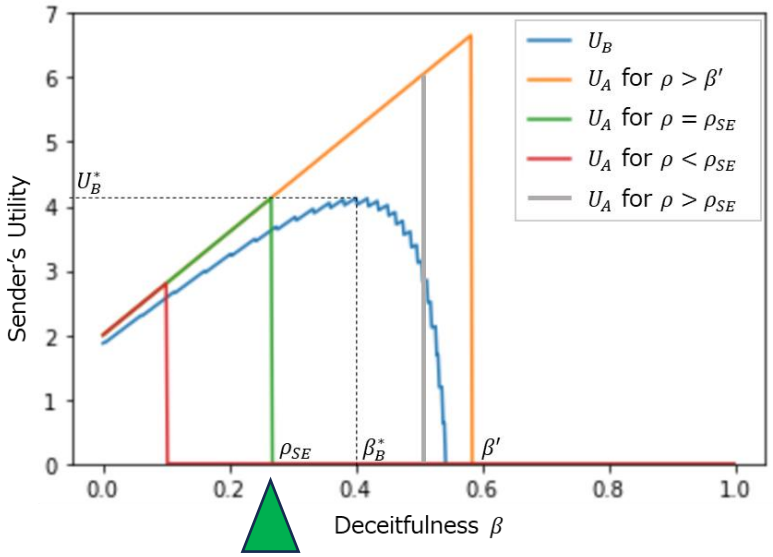

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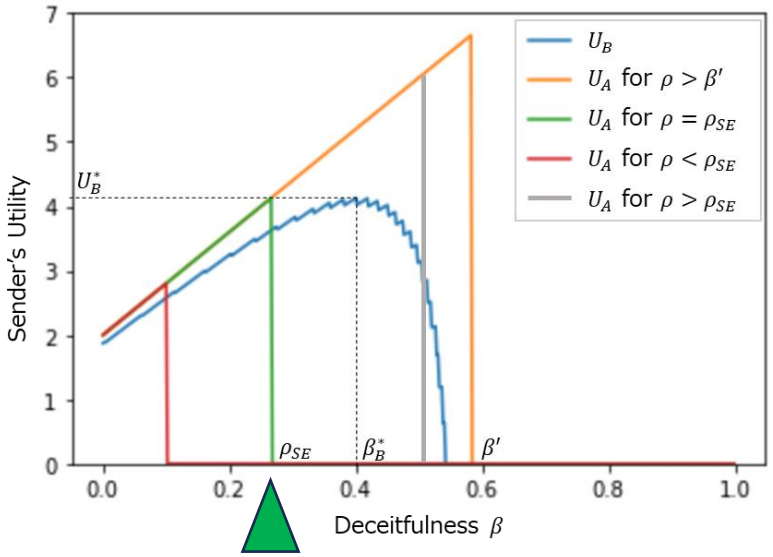

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- The best regulation for the entire society (because it allows many users to receive high quality information)

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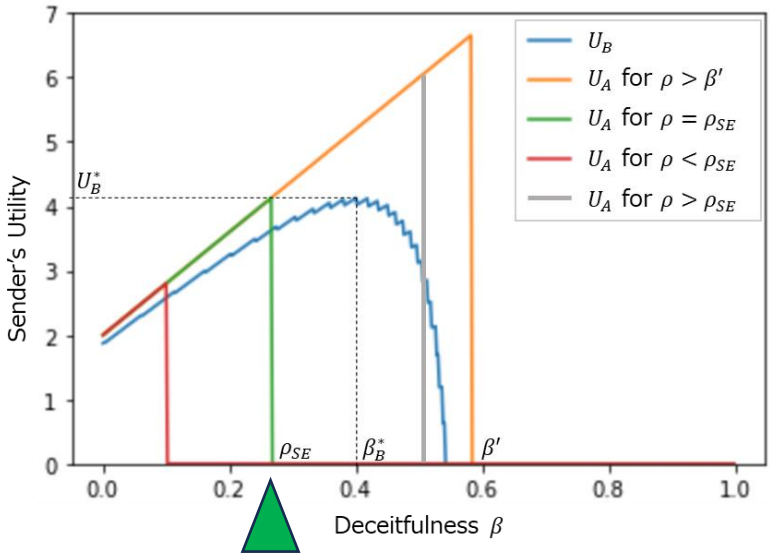

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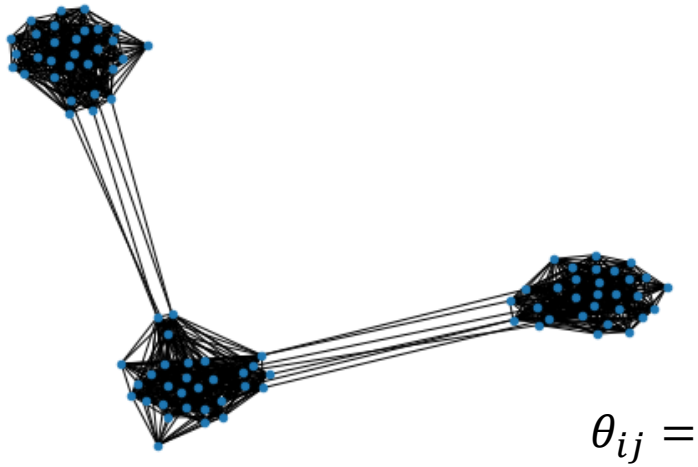
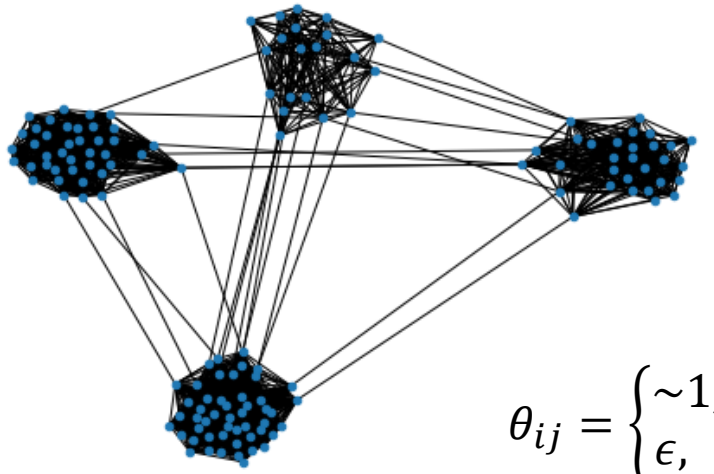
Next, we will investigate how Proposition 1 relates to the specific characteristics of networks and users.

Stochastic Block Model (Holland et al. 1983)



$$\theta_{ij} = \begin{cases} \sim 1, & i = j \\ \epsilon, & |i-j| = 1 \\ 0, & |i-j| > 1 \end{cases}$$



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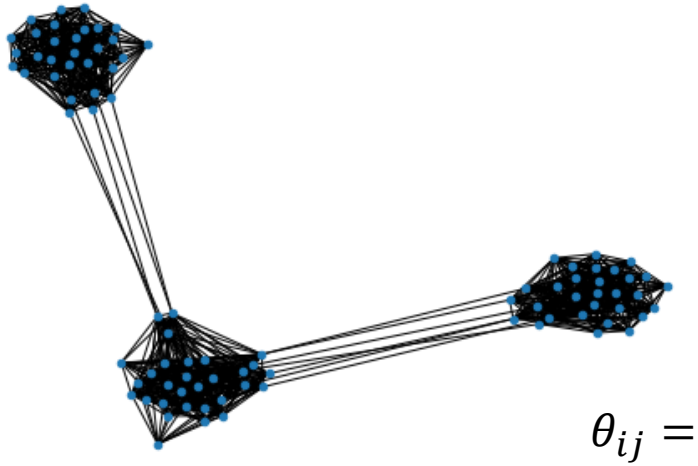
Stochastic Block Model (Holland et al. 1983)

Why SBM?

- It can express various real-world networks with community structures

(McPherson et al. 2001, Currarini et al. 2009)



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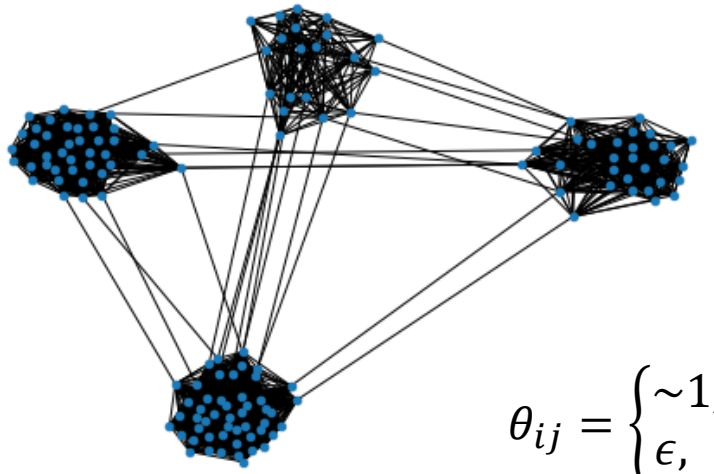

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Why SBM?

- It can express various real-world networks with community structures

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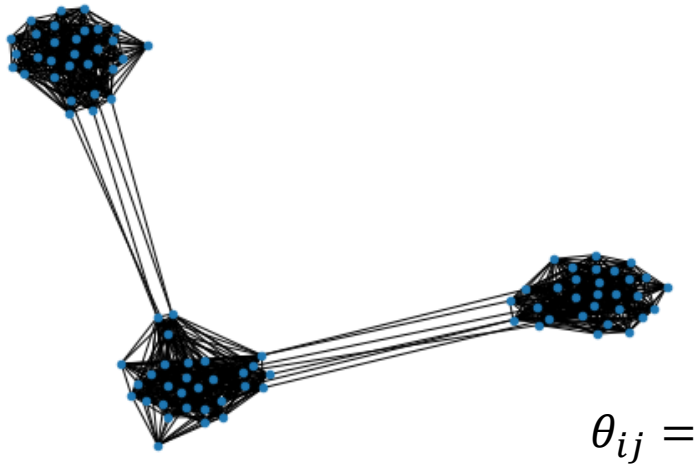
What is SBM?

- n_i: the number of users in community i
- θ_{ij}: the probability of friendship between users in community i, j



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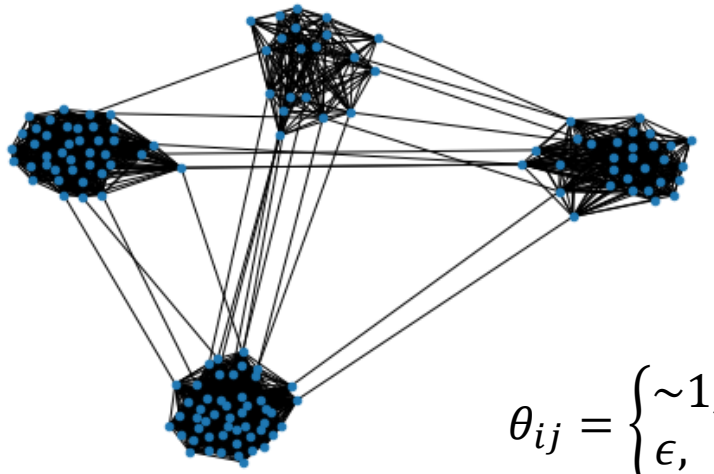

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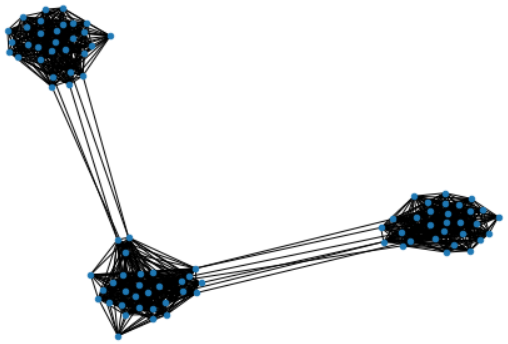
Stochastic Block Model

Chain of communities



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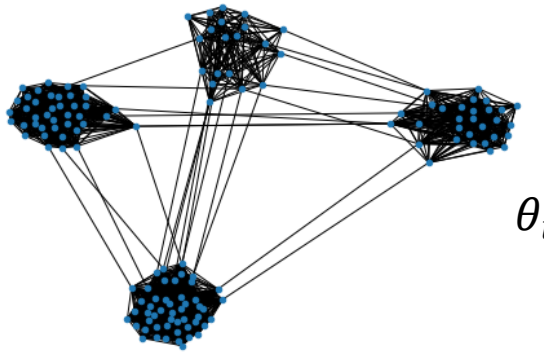
Complete graph of communities



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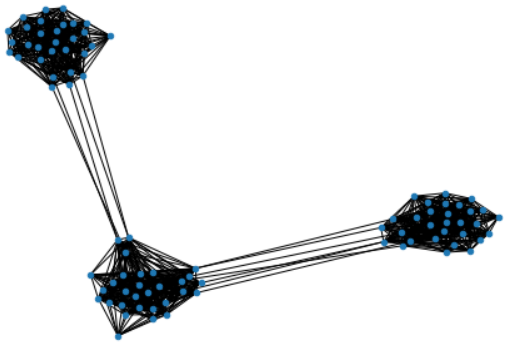

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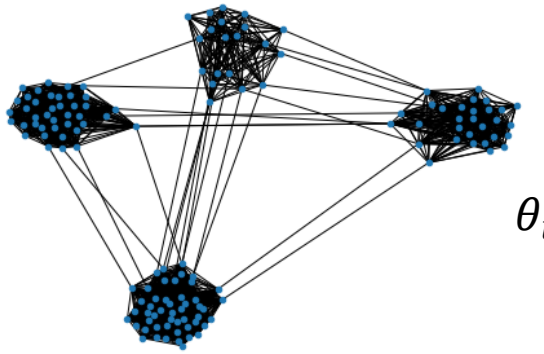

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Theorem 2 (Sufficient condition for $\rho_{SE} = 0$ in SBM)
The strictest effective regulation is $\rho_{SE} = 0$ if

$$n_j \theta_{jj} b_A - b_B \geq \mu(1-c) p_{iB} - \frac{\sum_{l=j+1}^{m} R_l}{\sum_{l=1}^{j} R_l} \mu c p_{iB}$$

for all $j = 1, \ldots, m$.

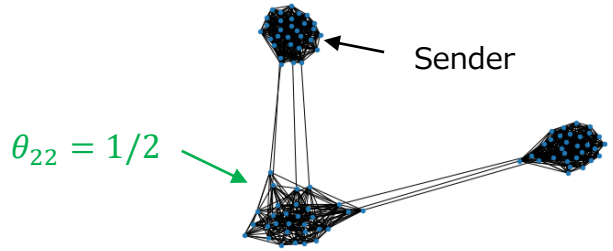
$n_1, n_2, \ldots, n_m$: #users in cluster

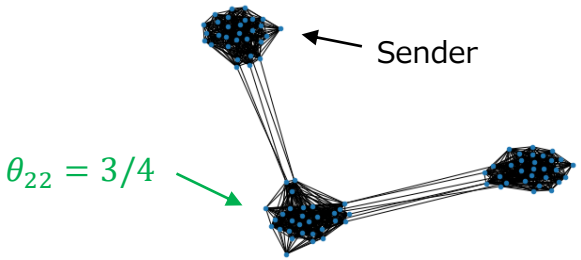
For chain of communities, $p_{iB} = \begin{cases} p & j = 1 \\ p^{2j-2} & 2 \leq j \leq m \end{cases}$, $R_j = n_j p^{2j-1}$.

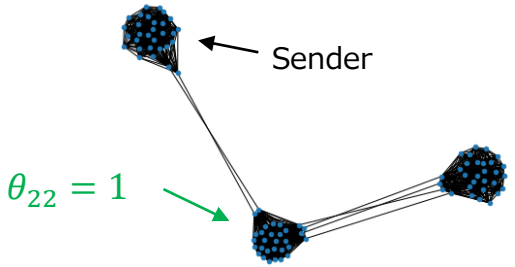
For complete graph of communities, $p_{iB} = \begin{cases} p & j = 1 \\ p^2 & 2 \leq j \leq m \end{cases}$, $R_j = \begin{cases} n_1 p & j = 1 \\ n_j p^3 & 2 \leq j \leq m \end{cases}$

See the meaning and implications in the following slides

Impact of in-between community structure on regulation







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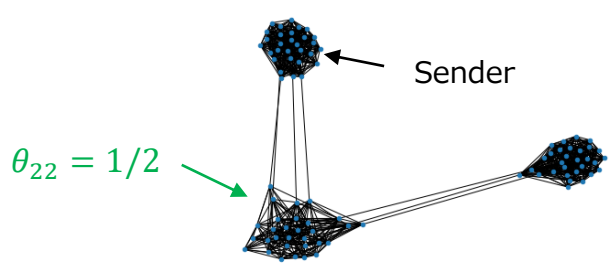
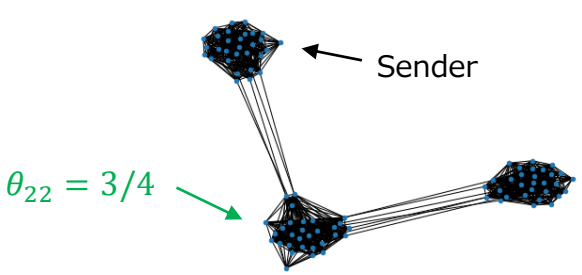
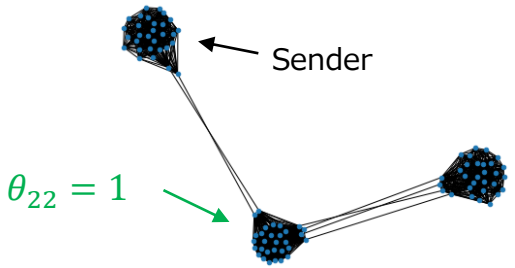
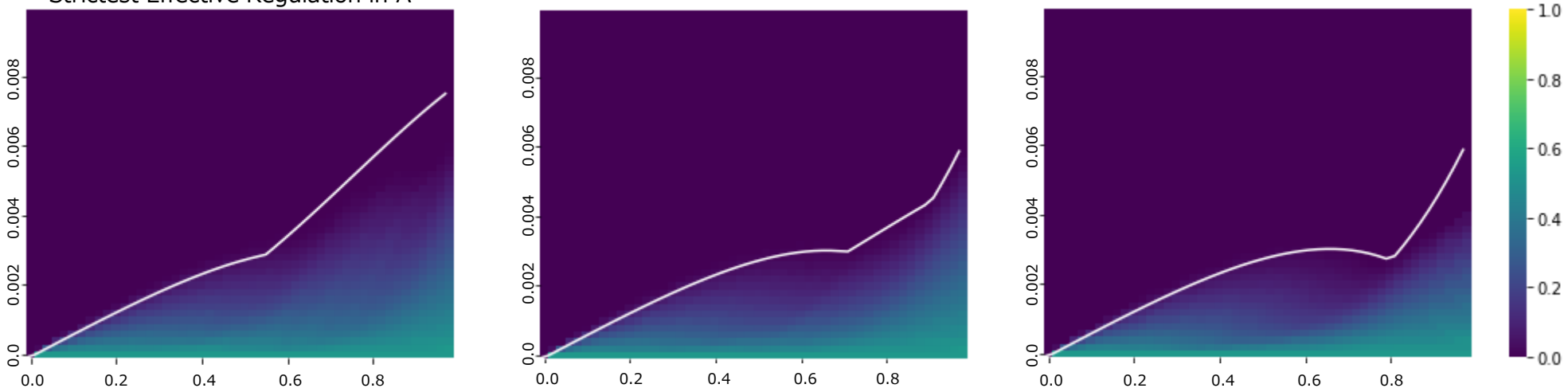






Strictest Effective Regulation in A

b_A: Social Interaction Quality in Platform A



p: Information-passing Probability

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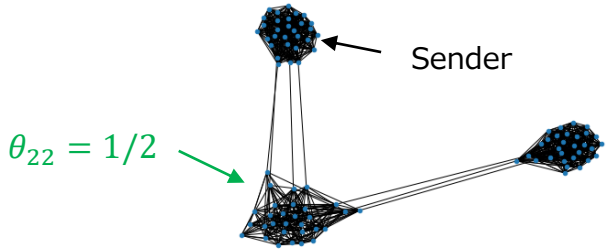

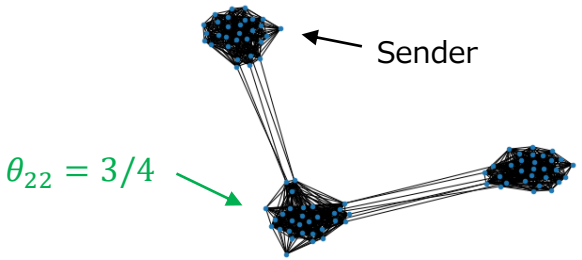

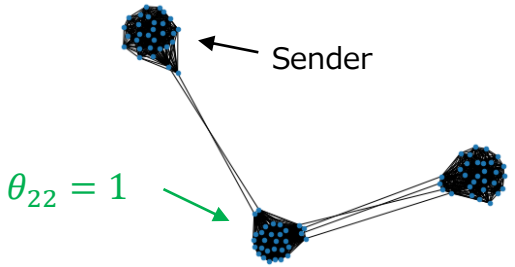

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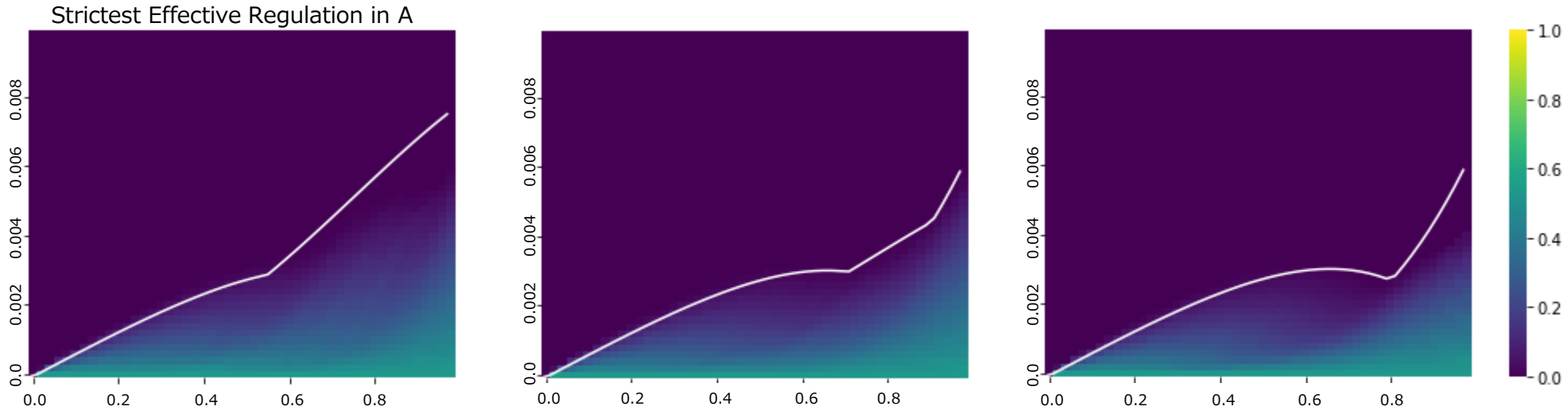
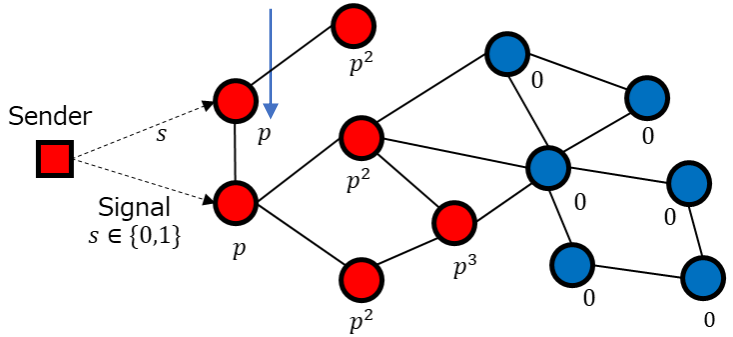
$$\Phi_{iJ} = b_J N_{iJ}$$





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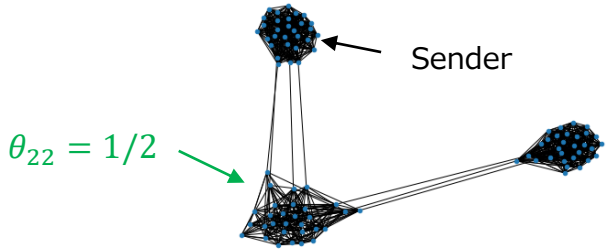

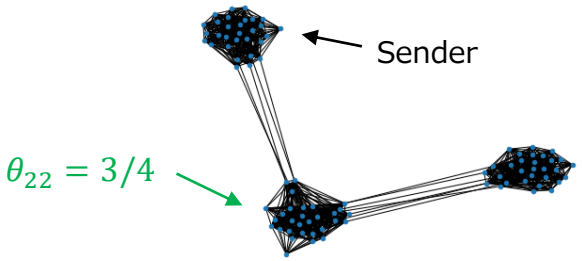

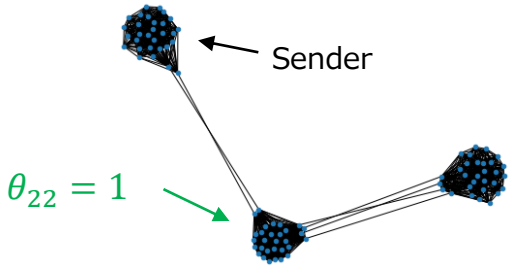

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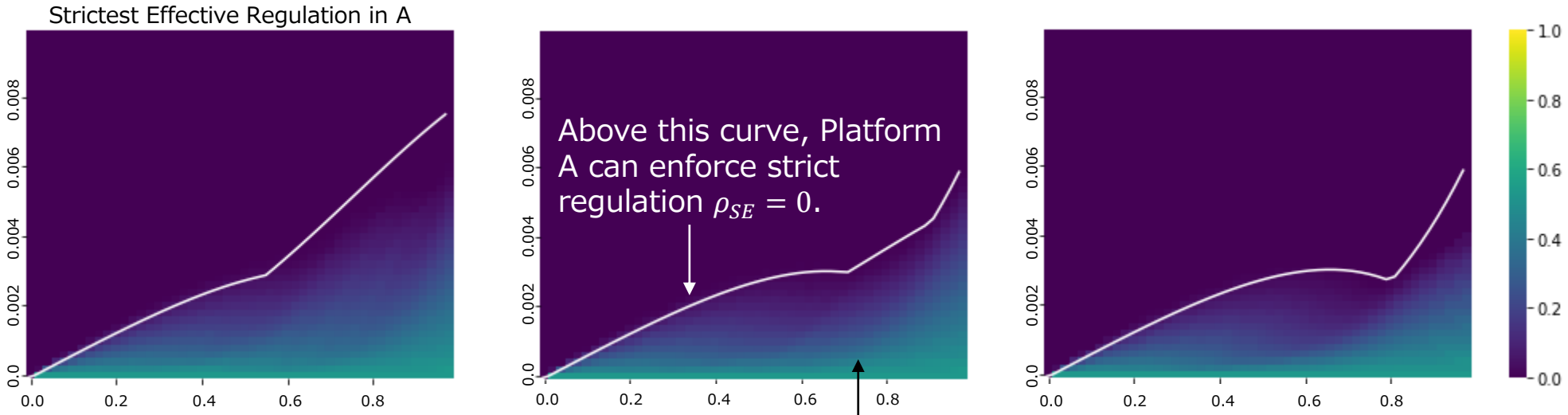

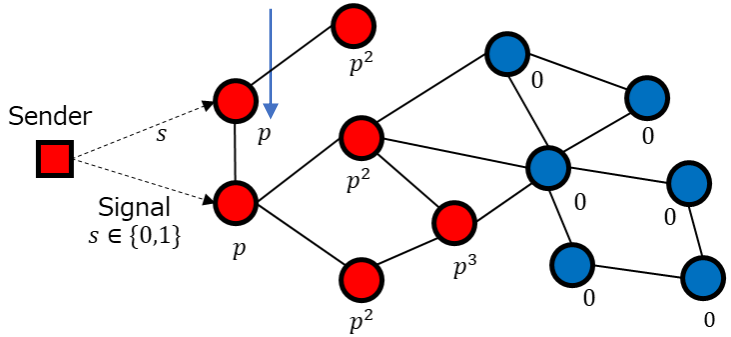

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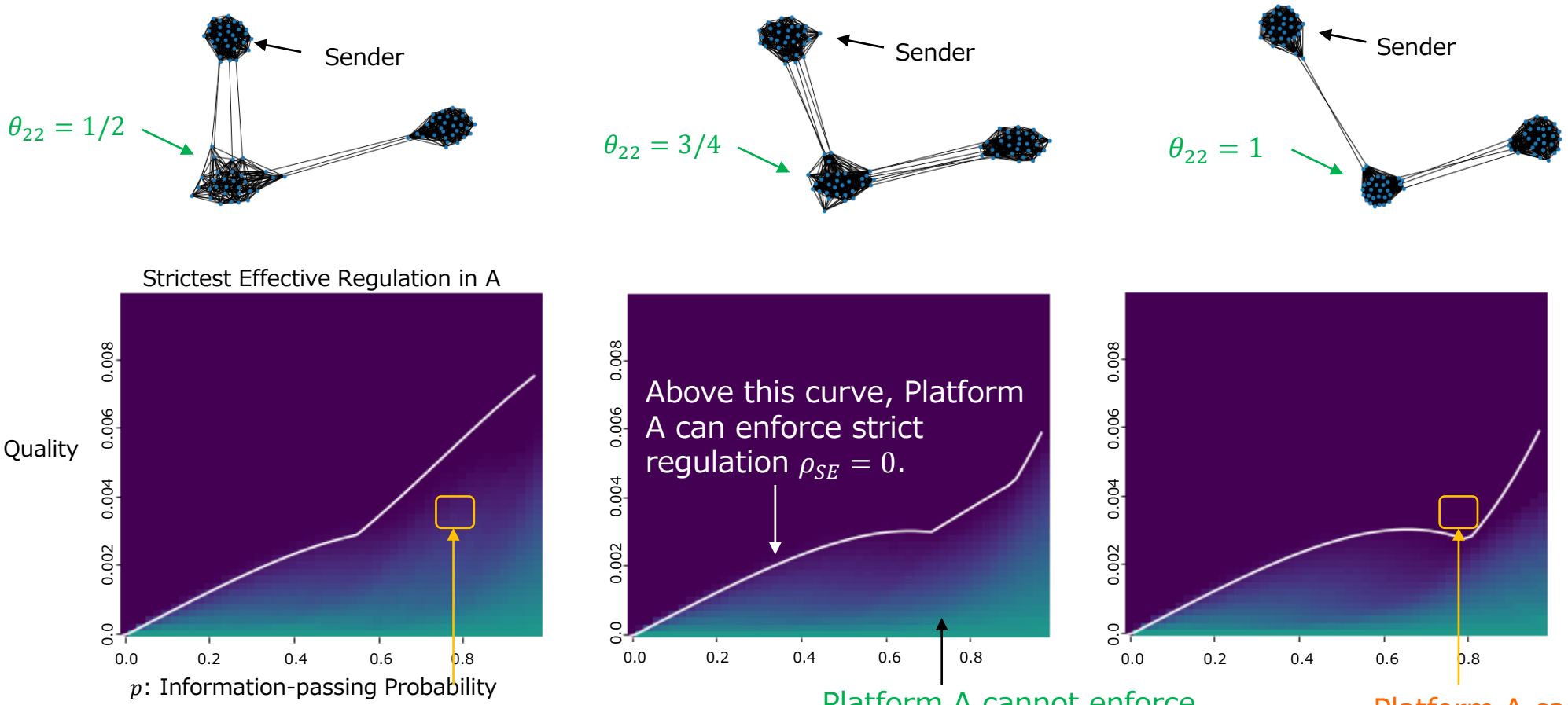

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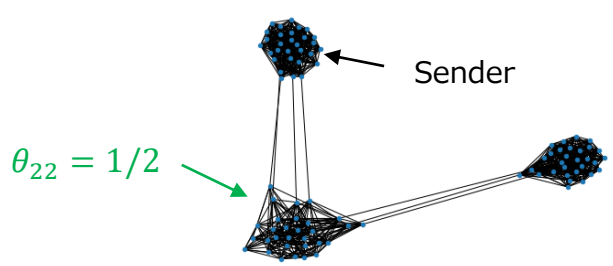
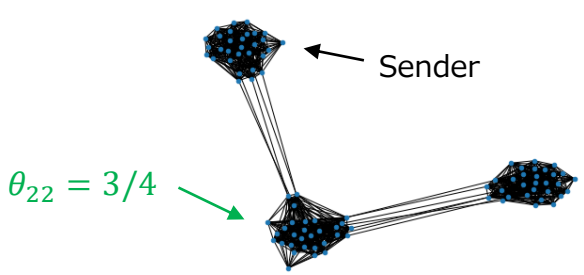
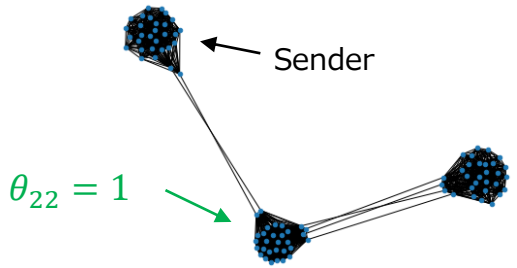
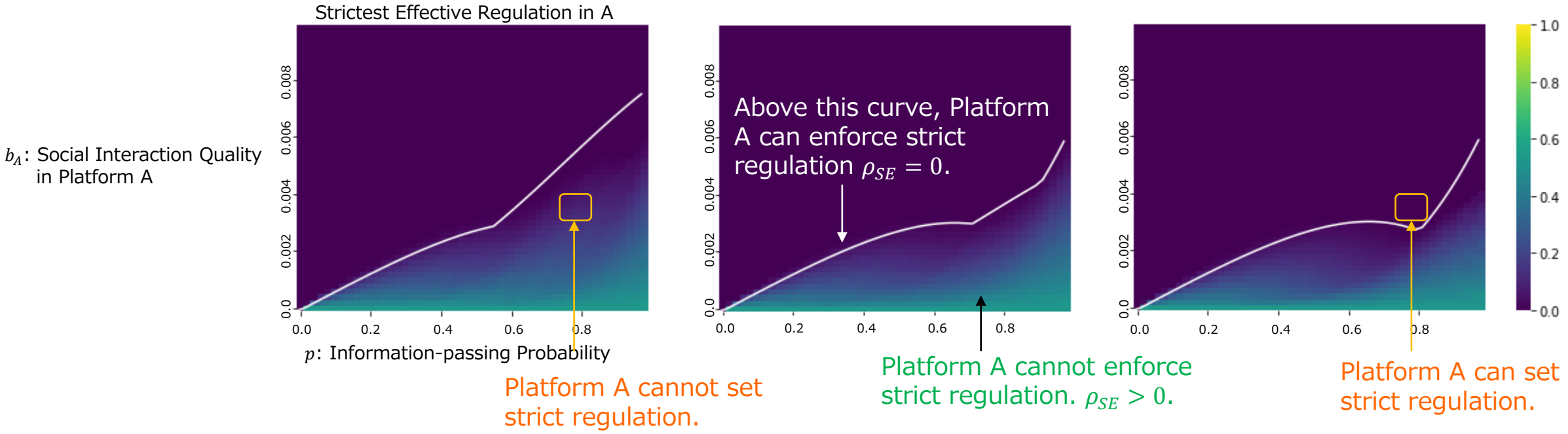


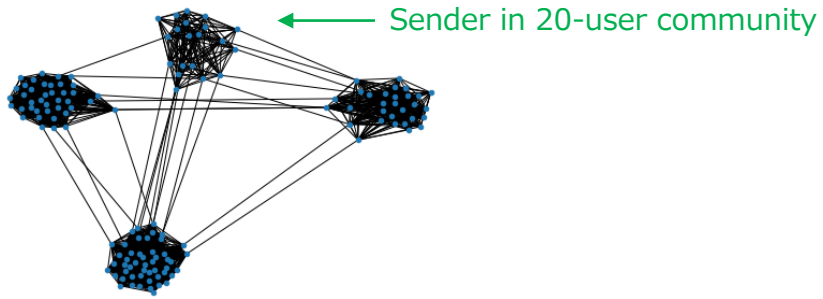


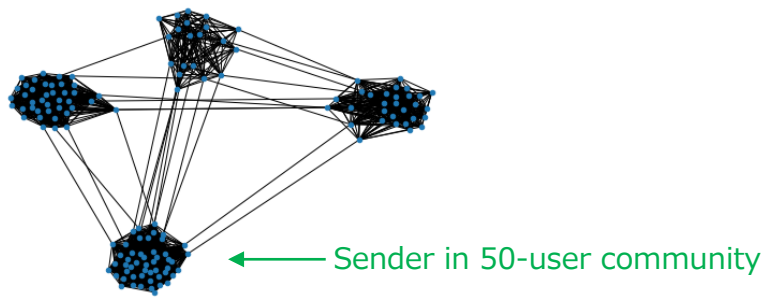




When p is high (information is diffusive), distant users become relatively important.
Since the tight community blocks user migration, it helps Platform A to set strict regulation.

Impact of Sender’s community size on regulation





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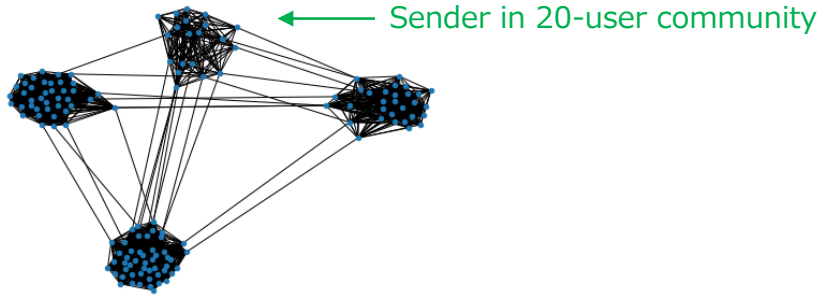

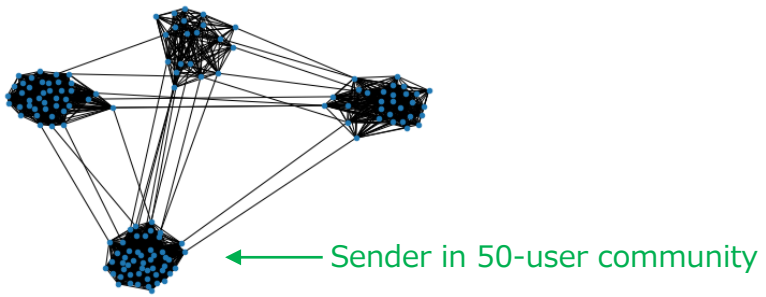

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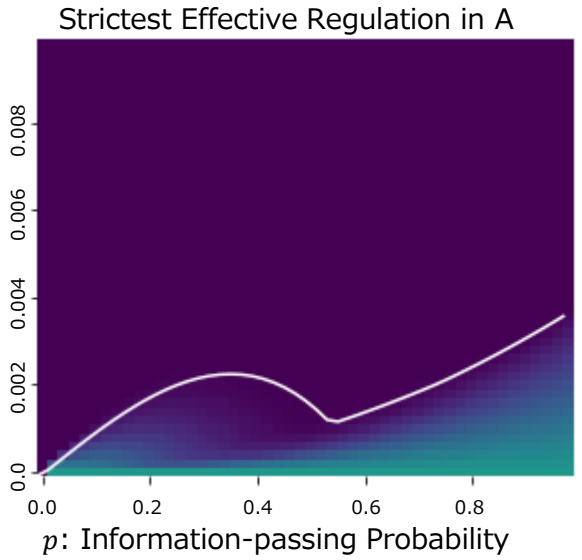

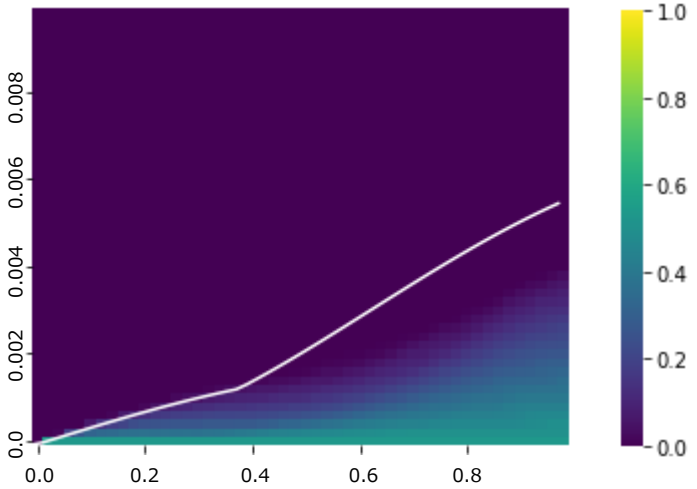

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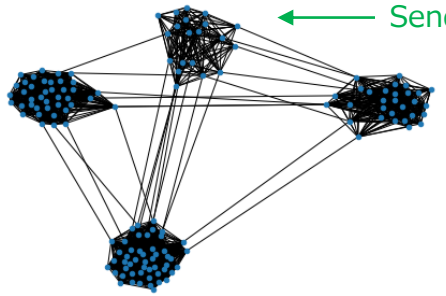
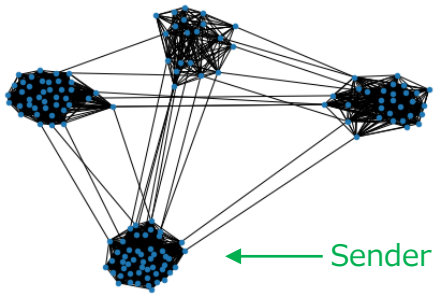


Sender in 20-user community



Sender in 50-user community

Strictest Effective Regulation in A

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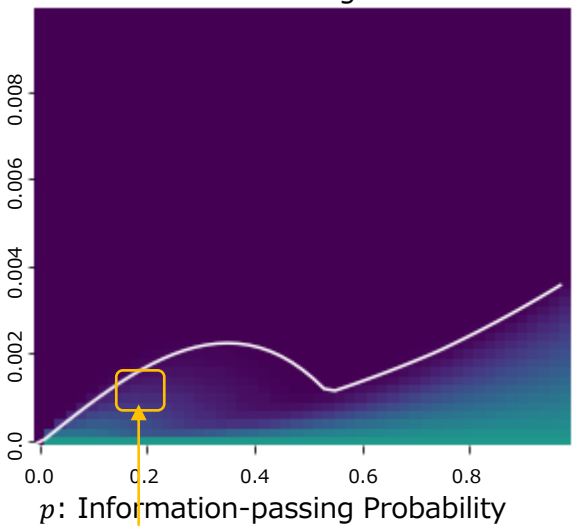

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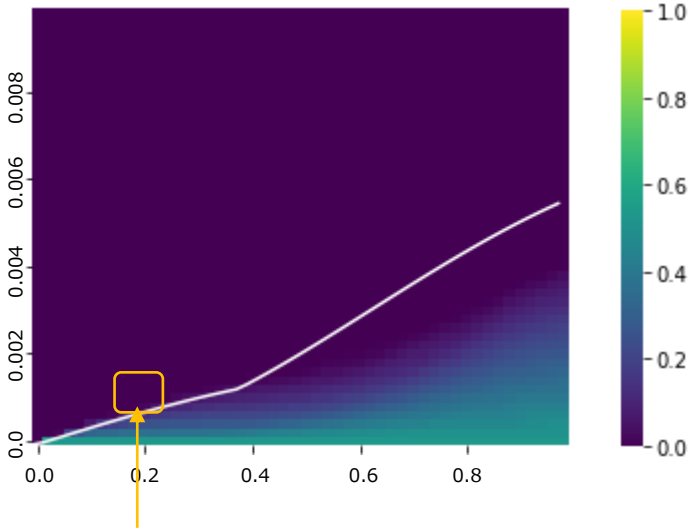
Platform A cannot set strict regulation.



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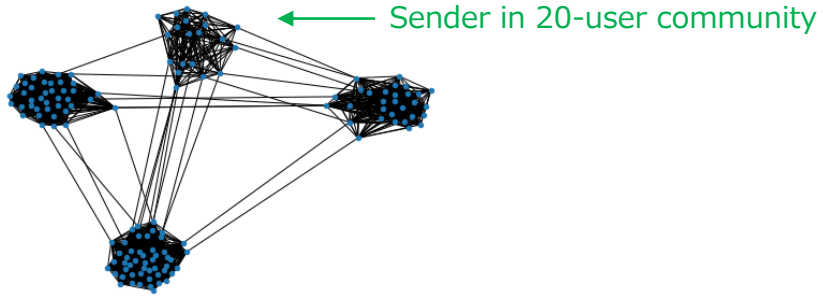

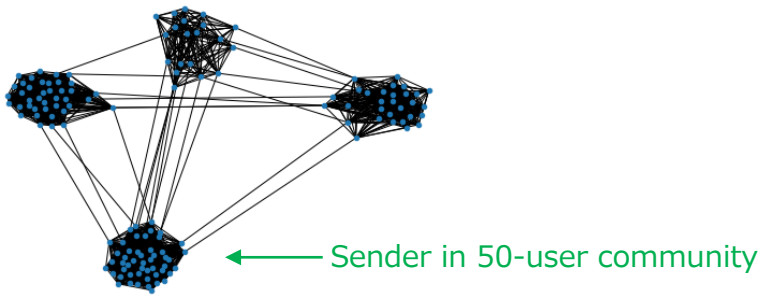

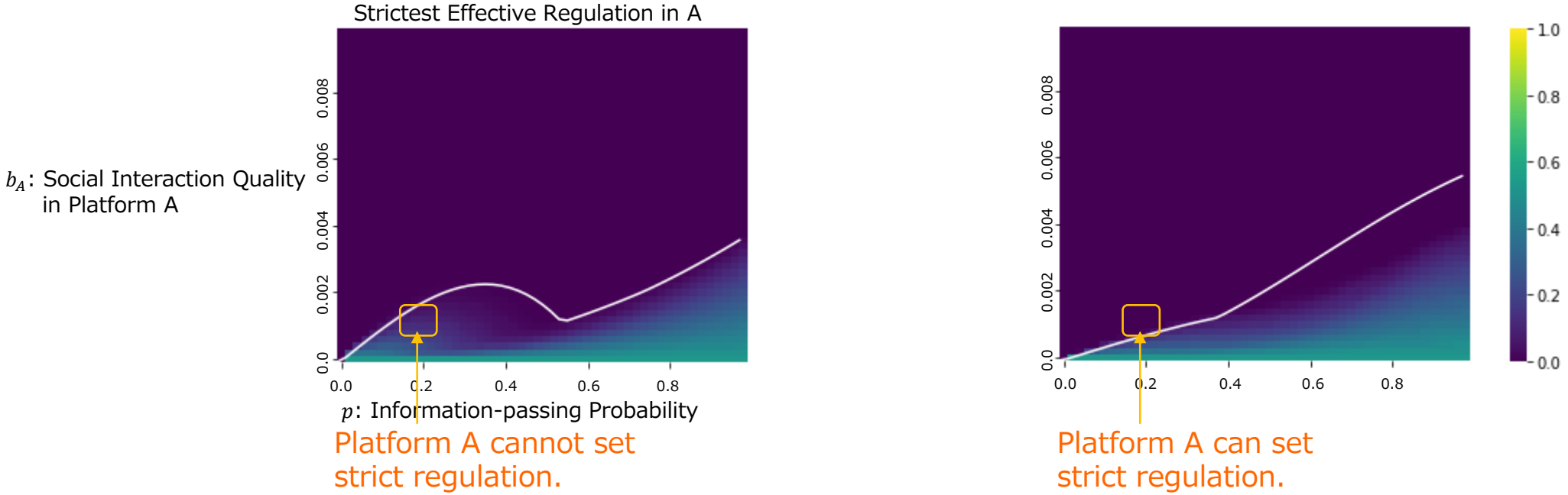

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Heterogeneous Users (Sympathizers & Non-sympathizers)

So far, all users had the same parameter c. Now, user i has c_i.

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Theorem 3 (Sufficient condition for $\rho_{SE} = 0$ in heterogeneous SBM)
Suppose users in community j have c_j. The strictest effective regulation is $\rho_{SE} = 0$ if

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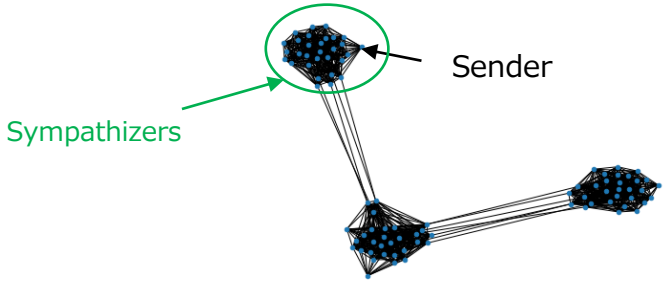
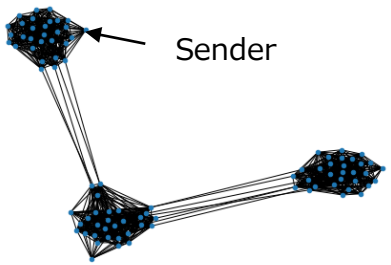
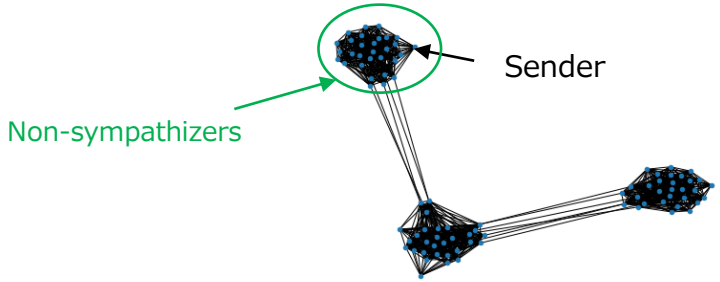
for all $j = 1, \ldots, m$.

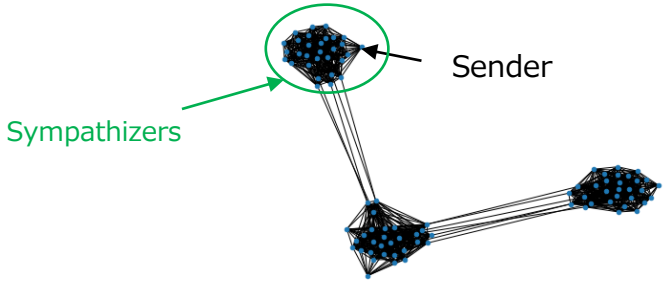
Heterogeneous Users (Sympathizers & Non-sympathizers)

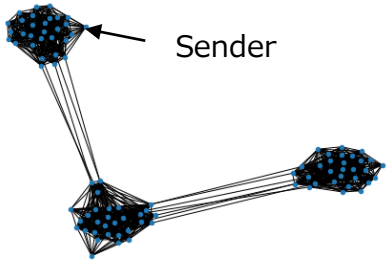


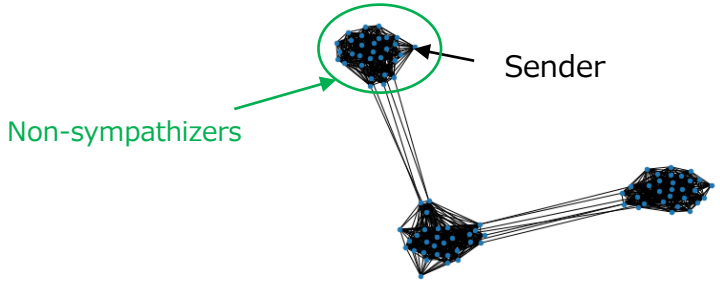


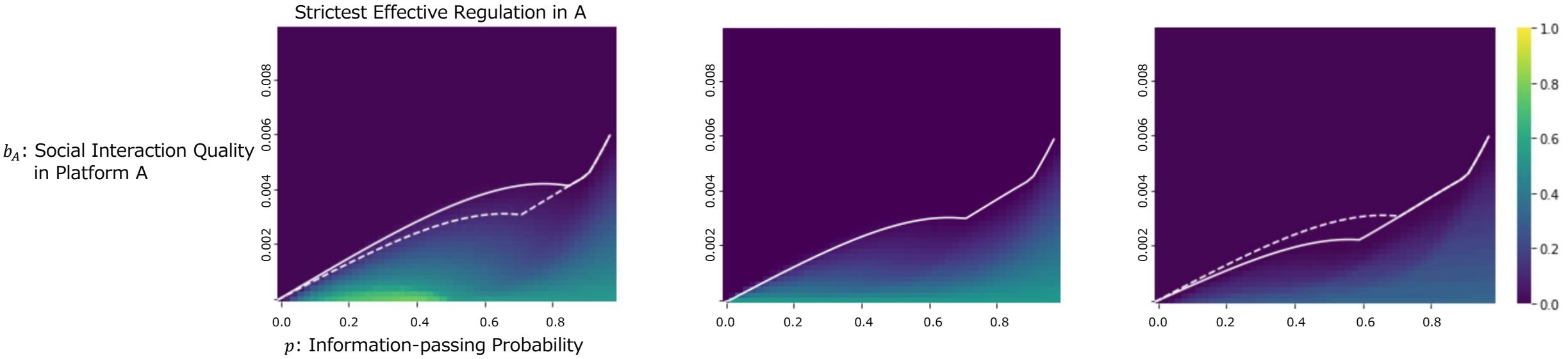


Heterogeneous Users (Sympathizers & Non-sympathizers)









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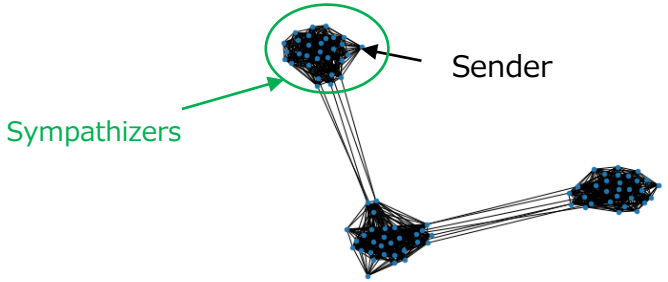

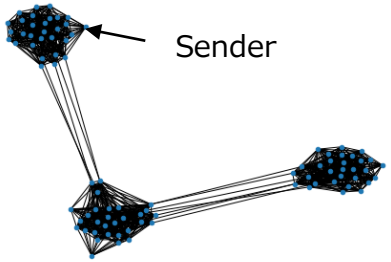

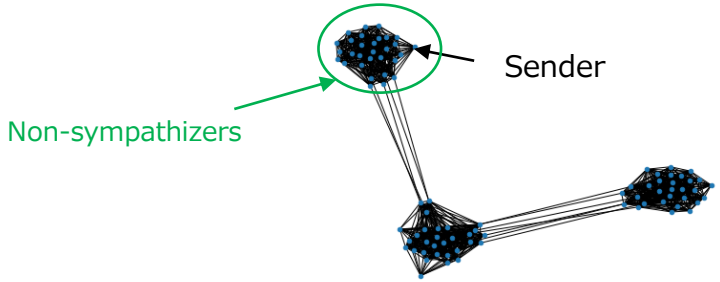

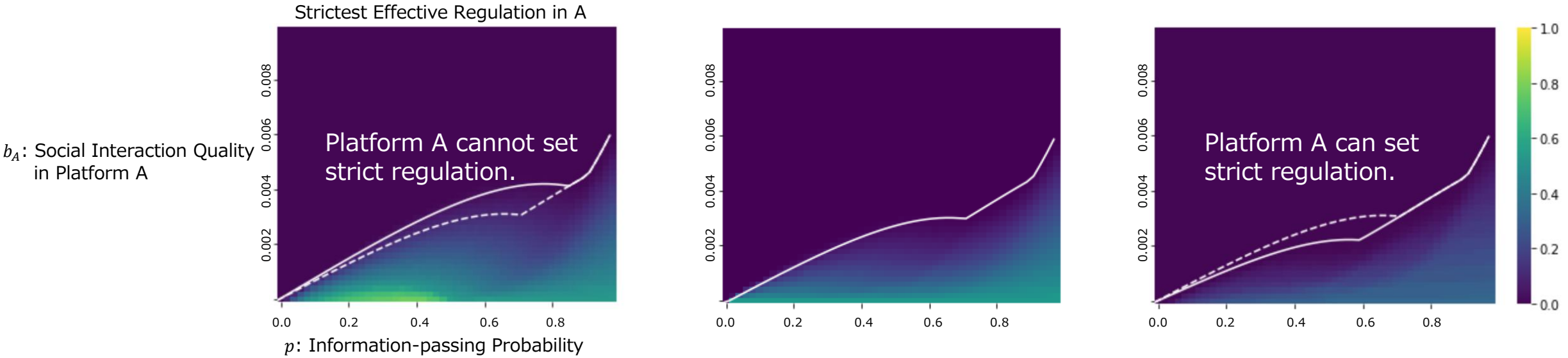

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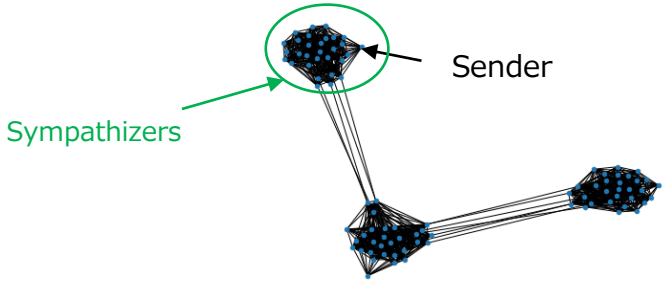

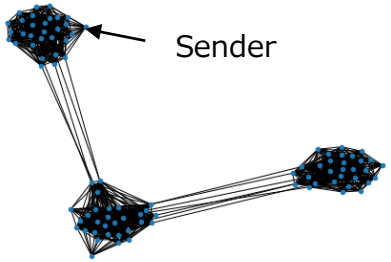

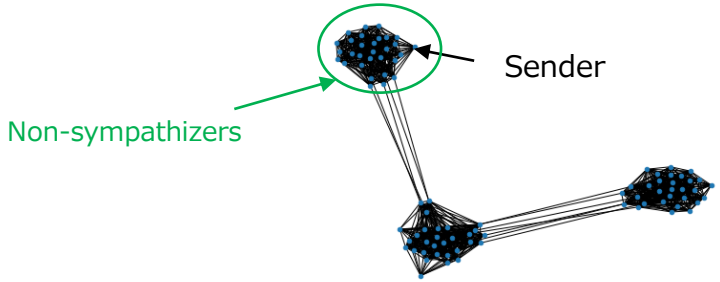

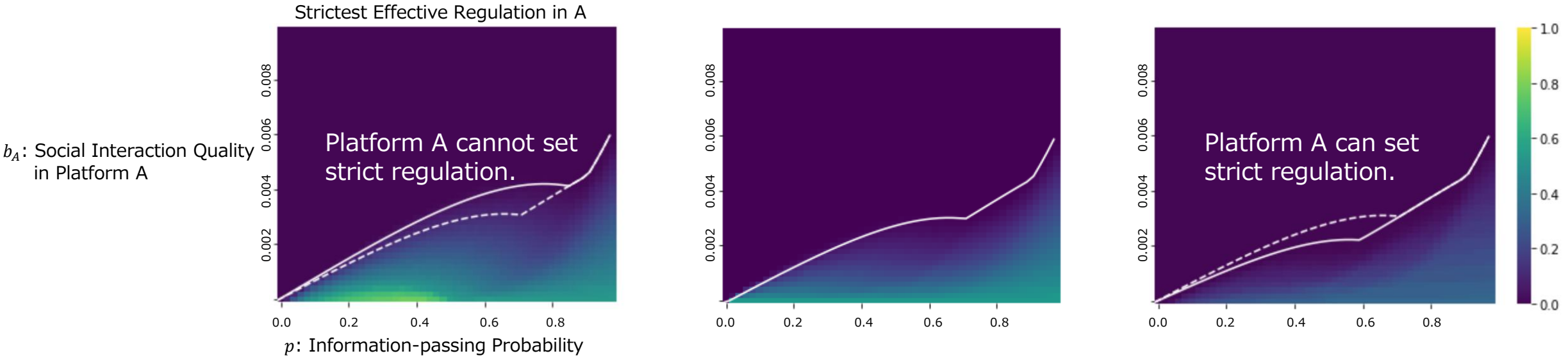

With sympathizers nearby, Sender has more power (Platform A can't set strict regulation).

But if p is high, sympathizers make less difference because distant users become important.

Discussion

- Why only two platforms? What if there are more than two?

  Since social media has positive externalities, the two-platform case can be considered as the worst case for the dominant platform A.

  (If users are distributed to many platforms, it is difficult for alternative platforms to become a strong competitor. So, platform A may enforce stricter regulation.)

- Why single-homing? What if a user can be on multiple platforms at the same time?

  1. Then, users would be on platform A anyways.
  2. Therefore, Platform A would enforce any strict regulation (i.e., $\rho_A = 0$).
  3. Influencer would move to platform B and become deceitful ($\beta = \beta'$).
  4. As a result, the information quality becomes worse despite the strict regulation.

  → For more discussion, we should consider the cost of multi-homing.

- Why singular influencer? What if there are some?

  Suppose multiple senders $S_1, S_2, \ldots$ have the access to the same world state and coordinate their strategies.

  Then this situation is almost the same as with a fictitious singular sender S connected to user nodes $S_1, S_2, \ldots$.

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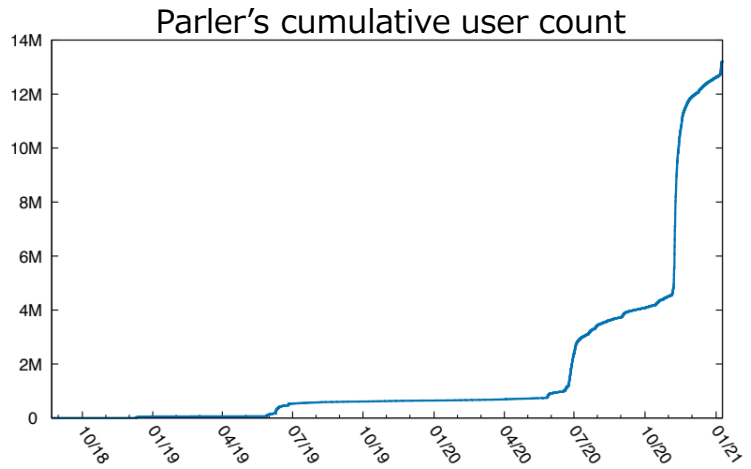
  - Because they have different value of p (the diffusiveness of messages)?
  - Because the network structures for Trump and his followers (sympathizers) are different?

Thanks for your attention!

I’m looking for collaboration partners/ideas!

Impact of regulation on platform competition

Alternative platform's user growth shows jumps in response to the choice by other platforms to label or remove content from prominent individuals



A new platform emerges as a result of intensified regulation in mainstream platforms