Equilibrium Inferences from the Choice of Forum: Two-audience Case

Juhyun Park*

This paper studies a signalling model with two audiences, in which the relationship between the sender and one audience is reverse to that of the sender and the other audience. When the sender chooses a forum after observing his type, the receivers make inferences about the sender's type not only from the message but also from the choice of forum; this influences the equilibrium. We present two models and analyze the equilibrium, which differ in whether the sender can commit the choice of communication or not. (*JEL* Classification: C72)

I. Introduction

This paper studies a signaling model with two audiences (or receivers), in which the relationship between the sender and one audience is reverse to that of the sender and the other audience. This model is a kind of costless signalling model (or cheap-talk) with an exogenous means of verifying messages. For example of this model, a firm faces both a union and bond-raters. A firm wants the union to believe that its profit is low. On the other hand, a firm wants bond-raters to perceive it as profitable.

In our model, the sender can send a verifiable message, which is costly to transmit, about his private information to two interested but uninformed audiences. This message is sent by either public or private communication. In public communication, both audiences observe the same message, whereas in private communication, each audience observes only his message. Therefore the sender can send the message

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only to one audience or send the same message to both audiences in private communication. When the sender chooses a forum after observing his type, the receivers make inferences about the sender's type not only from the message but also from the choice of forum; this influences the equilibrium.

We present two models in section II, which differ in the type of communication that is possible. In the first model, called the commitment model, the sender must choose whether to communicate publicly or privately. In this model, when one audience receives a public message, he is sure that the sender only communicates publicly to the other audience. That is, by choosing public disclosure the sender can commit himself not to communicate privately to each audience. The other model, called the no-commitment model, allows the sender to communicate in public and also to send a private message to one (or both) of the audiences. Therefore without commitment, one audience does not know whether the other audience receives a message or not. So the receivers' strategic inferences are influenced by the type of models.

In section III, we analyze sequential equilibria of Kreps and Wilson (1982) of our model. First we consider the equilibrium with only one forum and we extend to two forums. With two forums, commitment equilibria are very different from no-commitment equilibria, since the receivers' inferences depend on the type of models. When the cost of sending a verifiable message is small, every type must send a verifiable message to at least one audience in a no-commitment equilibrium. However in the commitment model, some sender type does not send a verifiable message in equilibrium provided the cost of disclosure is positive. Therefore, the sender can be happy by remaining *silent* and both receivers believe the fact that sender keeps *silent* in the commitment model. This is one of our main results. The welfare result shows that the sender's ex-ante expected utility in the commitment model is at least as large as that in the no-commitment model. The intuition behind this result is that in our model, it is ex-ante valuable for the sender not to send verifiable messages as possible. By making claim that the sender is not talking with the other audience, the ex-ante possibility of sending verifiable messages is reduced in equilibrium. This claim is only feasible in the commitment model.

Finally we briefly describe some related work with two-audience model. Bhattacharya and Ritter (1983) analyze a two-audience model, in which an informed firm faces the capital and product markets. The signal to the capital market about the firm's technology is observed by the other rival firm. They show that there exists a separating equilibrium in which the better a firm's technology, the more of its technology it chooses to reveal. However there is no opportunity to signal to the product market in their model. Therefore strategic inferences from the choice of forum do not arise.

Gertner, Gibbons and Scharfstein (1988) also consider a two-audience model similar to Bhattacharya and Ritter's. They use indirect revelation (capital-structure) instead of direct (verifiable messages) revelation. They demonstrate that all reasonable equilibria are either separating or pooling equilibria. They also do not allow the sender to send a message to the product market.

With a two-audience cheap-talk (non-verifiable messages) model, Farrell and Gibbons (1986) explain why the sender sends messages in private or in public and classify outcomes depending upon the agents' preferences. However their model does not capture the equilibrium inference from the choice of forum since each disclosure is determined exogenously.

II. Model

There are three agents, one Sender (S) and two receivers (R_1 and R_2). S has private information, called type t, which is drawn from $T = [\underline{t}, \bar{t}]$ according to density $f(t)$. Receivers have twice continuously differentiable von Neumann-Morgenstern utility functions, which are denoted by $u^i(y_i, t)$ for $i = 1, 2$. The sender's utility function is $v(y_1, y_2, t)$. The argument y_i is the response taken by R_i after observing S's signal m.

Throughout the paper we shall assume that

(1) t is uniformly distributed between $\underline{t}$ and $\bar{t}$, where $\underline{t} = 0$.
(2) $u^1(y_1, t) = -(y_1 - \alpha t)^2$, where $\alpha \geq 1$
(3) $u^2(y_2, t) = -(y_2 - \bar{t} + t)^2$
(4) $v(y_1, y_2, t) = y_1 + y_2 - c(m(t))$

We assume (1) for simplicity. Assumptions (2) and (3) are utility functions of R_1 and R_2. Each $u^i(y_i, t)$ has a unique maximum in y_i given t. Furthermore the best value of y_1 and y_2 are linearly increasing and decreasing in t respectively. We assume the quadratic utility function as above for simplicity.[1] Assumption (4) tells that S's utility is the sum

[1]Any kind of utility function is satisfactory as long as the best value of y_1 and y_2 are linearly increasing and decreasing in t respectively.

of receivers' responses minus cost of verifiable messages.[2] From (2), large α induces large y_1. Therefore as α increases, R_1 is relatively more important to the sender. That is, α represents the importance of R_1 when that of R_2 is normalized to one. From (2) to (4), the relationship between the sender and R_1 is reverse that of the sender and R_2. That is, S wants R_1 to believe that his type is high. On the other hand, S wants R_2 to believe that it is low. For example, a firm faces both a union and bond-raters. A type here represents the firm's profit. A firms wants the union to believe that its profit is low. On the other hand, a firm wants bond-raters to perceive it as profitable.

If the sender can communicate only by non-verifiable messages (cheap-talk), then no information is revealed since the sender's utility over the receivers' actions is independent of the sender's true type, i.e., every sender type prefers high actions (y_1 + y_2) as long as $\alpha > 1$. Farrell and Gibbons (1988) classify this case as "no-communication".

We assume that the sender can send verifiable messages either publicly or privately. The cost of sending the signal is c per receiver. By allowing verifiable messages, the sender's incentives of whether to send the message or not and how to send it depend on the type of sender. Therefore the receivers infer the sender's type not only from the message but also from the choice of communication.

We present two different models described in introduction. In the commitment model, the sender must choose whether to communicate publicly or privately. In this model, when one audience receives a public message, he is sure that the sender only communicates publicly to the other audience. That is, by choosing public disclosure the sender can commit himself not to communicate privately to each audience. The other model, called the no-commitment model, allows the sender to communicate in public and also to send a private message to one (or both) of the audiences. Therefore without commitment, the sender can not make a claim not to talk privately or publicly.

The rules of the game are

1) A type of model, either commitment or no-commitment model, is determined exogenously.

2) Nature chooses $t \in T$.

3) After observing t, S chooses whether to communicate publicly or

[2]The cost of verifiable message does not depend on type t directly. It depends on whether sender sends verifiable messages or not. However whether to send verifiable messages or not depend on the type of sender.

privately and also decides to send a message or not depending on the type of model.

4) Receivers choose actions based on beliefs from the choice of forum and the message, which determine players' payoffs.

First, we discuss the sender's strategy in the commitment model. There are five pure strategies:

(a) verify to R_1 only,
(b) verify to R_2 only,
(c) do not verify to both in private,
(d) do not verify in public,
(e) verify to both.

If the sender chooses private disclosure, then he decides to send the message or not to each audience. In this case, there are four strategies: (a), (b), (c) and (e). Similarly if the sender chooses public disclosure, he has two strategies, that is, (d) and (e). Notice that the sender never sends verifiable messages in public and also in private to one (or both) of the audiences in equilibrium, since the sender has to pay the cost of disclosure twice at least for one of the audiences. Therefore the strategy (e) in private is same as that in public.

The set of pure strategies in the commitment model for the sender, denoted M, is $M = \{(a), (b), (c), (d), (e)\}$

In the no-commitment model, the sender can communicate in public and also send a private message to one (or both) of the audiences. Therefore (d) is not feasible without commitment and all possible sender's strategies are (a), (b), (c) and (e). Therefore the only difference between the two models is whether (d) is feasible or not.

We also need to define beliefs held by the receivers after observing S's messages and the choice of forum.

Let $\mu_i(t \mid m)$ be R_i's beliefs on t at the information set after when S chooses a strategy $m \in M$. The relationships between the beliefs are

(i) $\mu_1(t \mid b) = \mu_1(t \mid c)$

(ii) $\mu_2(t \mid a) = \mu_2(t \mid c)$

(iii) $\mu_1(t \mid d) = \mu_2(t \mid d)$.

The receivers cannot observe S's signaling rules or strategies, nodes from the strategies (b) and (c) lie in the same information set for R_1. Similarly nodes from (a) and (c) lie in the same information set for R_2. Notice that receivers can have different information sets in private communication. However the receivers have same beliefs in public communication.

A Sequential Equilibrium (Kreps-Wilson 1982) in our model consist of triple $(m^*(t), y^*(m), \mu^*(t|m))$, where $m^*(t) \in M$, $y^*(m) = (y_1^*(m), y_2^*(m))$ is the vector of receivers' actions and $\mu^*(t|m) = (\mu_1^*(t|m), \mu_2^*(t|m))$ is the receivers' beliefs such that

1) Sender's maximization:
for each t, $m^*(t)$ is the best response to $y^*(m)$, that is,
$m^* \in \text{argmax}_{m \in M}\, v(y_1^*(m), y_2^*(m), t)$
2) Receivers' maximization:
for all m, $y_i^*(m)$ is the best response given beliefs $\mu^*(t|m)$, that is,
$y_i^*(m) = \text{argmax}_{m \in R} \int_0^{\bar{t}} u^i(y_i, t)\, \mu_i^*(t|m)dt$ for $i = 1, 2$
where $\mu_i^*(t|m)$ satisfies (i) to (iii).

We assume that players are Baysian rational in the sense that Bayes' rule determines $\mu(t|m)$ whenever m is in the range of equilibrium schedule. However if the receivers observe messages that are not in the range of equilibrium schedule, then Bayes' rule cannot be used to update the priori. Further, this type of model does not require to check consistency criterion in sequential equilibria, since messages are transmitted only once.

III. Equilibria

We will characterize sequential equilibria in this section. For simplicity we redefine y_i to the case in which R_i receives no messages, since we can use the true type of S directly for the response to a verifiable message. Similarly y_p is the response from no message in public.

If the sender type t uses strategy (a), then R_1 responds αt by observing t from a verifiable message and R_2 responds y_2 by receiving no messages. The costs of verifying to R_1 is c. Therefore S's payoff from (a) is $\alpha t - c + y_2$. Similarly we can get all S's payoffs, which are shown in Table 1.

Payoffs from (a) and (e) are strictly increasing in t. Furthermore the difference between the payoff from (a) and that from (e) is also strictly increasing in t. Similarly the payoffs from (b) and (b)—(e) are strictly decreasing in t. Therefore it is clear that set of types that use strategy (a), simply we shall write set (a), is of the form $[t_a, \bar{t}]$, set (e) is of the form $[t_e, t_a]$ and set (b) is of the form $[0, t_b]$. Either one of (c) and (d) is empty, or $y_1 + y_2 = y_p$.

The case in which S has only one forum will be considered and it will be extended to the case with two forums.

TABLE 1

Strategy	Payoff
(a) verify to R^1 only	$\alpha t - c + y_2$
(b) verify to R^2 only	$\bar{t} - t - c + y_1$
(c) do not verify to both	$y_1 + y_2$
(d) do not verify in public	y_p
(e) verify to both	$(\alpha - 1)t + \bar{t} - 2c$

A. Private Disclosure

When S has only private disclosure, the possible choices for S are (a), (b), (c) and (e). Since S can send a different message to each audience, this model can be thought of as two single-audience models.

Let us consider S's problem with R_1. S's choice is whether to send a verifiable message or not. The payoff from not sending a message is y_1, which is independent of t, and that from sending a verifiable message is $\alpha t - c$ given t. The set of S types who send verifiable messages is of the form $[t_1, \bar{t}]$, since the difference between two payoffs $(\alpha t - c - y_1)$ is strictly increasing in t. The boundary type t_1 is indifferent between sending and not sending a message. That is, $\alpha t_1 - c = y_1$. Therefore $t_1 = 2c/(\alpha - 1)$ since $y_1 = \alpha\mu_1$ and $\mu_1 = t_1/2$.

Let us consider the case of R_2. The payoff from sending a message to R_2 is $\bar{t} - t - c$, which is strictly decreasing in t. Therefore the set of S types who send verifiable messages to R_2 is of the form $[0, t_2]$. The "boundary" equality gives $t_2 = \bar{t} - 2c$, since $y_2 = \bar{t} - \mu_2$ and $\mu_2 = (\bar{t} - t_2)/2$. The equilibrium strategy depends on the values of t_1 and t_2. For example if $0 < t_1 < t_2 < \bar{t}$, then S chooses (a) if $t \geq t_2$, (e) if $t_1 < t < t_2$ and (b) otherwise.

We summarize the result in Proposition 1.

Proposition 1

When only private disclosure is allowed, there exists a unique equilibrium except when $\bar{t} = 2c/\alpha$ and $\bar{t} = 2c$, which are boundary values.

The sender's strategies are

1) If $\bar{t} \leq 2c/\alpha$, then S chooses (c).

2) If $2c/\alpha < \bar{t} < 2c$, then S chooses $\begin{cases} \text{(a) if } t \geq 2c/\alpha \\ \text{(c) otherwise} \end{cases}$

3) If $2c \leq \bar{t} \leq 2c/\alpha + 2c$, then S chooses $\begin{cases} \text{(a) if } t \geq 2c/\alpha \\ \text{(c) If } \bar{t} - 2c \leq t < 2c/\alpha \\ \text{(b) otherwise} \end{cases}$

4) If $2c/\alpha + 2c < \bar{t}$, then S chooses

$$\begin{cases} \text{(a) if } t \geq \bar{t} - 2c \\ \text{(e) if } 2c/\alpha \leq t < \bar{t} - 2c \\ \text{(b) otherwise} \end{cases}$$

B. Public Disclosure

When S has only public disclosure, the possible choices for S are (d) and (e). If $\alpha = 1$, the payoff from (d) is always greater than that of (e). Therefore the equilibrium strategy is (d) only. In this case there are multiple equilibria from pooling to separating since the payoff from (d) is $\bar{t}$ independent of t.

If $\alpha > 1$, then set (e) is of the form $[t_e, \bar{t}]$, since the payoff from (e) – (d) is strictly increasing in t. The boundary equality $(\alpha - 1)t_e + \bar{t} - 2c = y_p$, gives $t_e = 4c/(\alpha - 1)$, since $y_p = \alpha\mu_p + \bar{t} - \mu_p$ where μ_p is the beliefs in public communication. That is , $\mu_p = \mu_1 = \mu_2$ by (iii).

Proposition 2

When only public disclosure is allowed, there exist a unique equilibrium except when $\bar{t} = 4c/(\alpha - 1)$. The sender's strategies in equilibrium are

1) If $\bar{t} \leq 4c/(\alpha - 1)$, then S chooses (d).

2) If $\bar{t} > 4c/(\alpha - 1)$, then S chooses $\begin{cases} \text{(e) if } t \geq 4c/(\alpha - 1) \\ \text{(d) otherwise} \end{cases}$

C. Private and Public Disclosure

With two forums, S will choose a forum depending on his type. Therefore the receivers can infer S's type not only from the message but also from the choice of forum. There are two types of model depending on S's ability to commit or not. We consider the no-commitment model first in the following section.

1) No-commitment Equilibria

If S has no power to commit, then the sender cannot make a claim that he will not talk to the other audience privately. Therefore (d) is not feasible and the set of S's strategies is

M = {(a), (b), (c), (e)}

Therefore no-commitment equilibrium is exactly the same as Proposition 1, which gives following proposition.

Proposition 3

If the cost of disclosure in public is not less than that in private, no-commitment equilibrium with two forums is exactly same as that of private disclosure only.

Proof: By definition of no-commitment the strategy of (d) is not feasible. The strategy of (e) in public is no efficient that in private, since the cost of disclosure in private is not larger than that of in public.

Q.E.D.

2) Commitment Equilibria

We will consider commitment equilibria in this section. In the commitment model, the sender must choose whether to communicate publicly or privately. In this model, when one audience receives a public message, he is sure that the sender only communicates publicly to the other audience. That is, by choosing public disclosure the sender can commit himself not to communicate privately to each audience. In this case the receivers' strategic inferences are directly affected by choice of forum. With commitment all possible S's strategies are (a), (b), (c), (d) and (e). (see Table 1)

Proposition 4

What $\alpha = 1$, there exist a unique equilibrium outcome, which is $\bar{t}$. The equilibrium strategy for S is (c) or (d). Furthermore if $\bar{t} > 2c$, then (d) is unique equilibrium strategy.

Proof: If $\alpha = 1$, the payoff from (d) is $\bar{t}$, which is independent of t. Therefore S never chooses (e) since the payoff from (e) is $\bar{t} - 2c$. Furthermore, $y_1 + y_2 \le y_p = \bar{t}$, since $y_1 + y_2 = \mu_1 + \bar{t} - \mu_2$ and $\mu_1 \le \mu_2$. The equality holds only if $\mu_1 = \mu_2$, that implies both set (a) and (b) are empty. If $y_1 + y_2 < y_p$, then set (c) must be empty. Furthermore set (a) or set (b) can not be equilibrium. Suppose some sender types use (a), then the payoff of sender type $t = \mu_2$ from (a) is $\bar{t} - c$. Therefore this type will deviate to (d). Similarly the payoff of sender type $t = \mu_1$ from (b) is $\bar{t} - c$.

Now we want to show that (d) is the unique equilibrium strategy when $\bar{t} > 2c$. Suppose some sender types use strategy (c) in equilibrium. Then $\mu_1 = \mu_2 = \bar{t}/2$ and the payoff is $\bar{t}$ independent of t. However if type $\bar{t}$ deviates to (a), then he will get $\bar{t} - c + \bar{t} - \mu_2 = \bar{t} + \bar{t}/2 - c$. Therefore if $\bar{t} > 2c$ then the payoff from deviating to (a) is larger than the payoff from the equilibrium strategy. Therefore only (d) is possible in equilibrium with $\bar{t} > 2c$. In the case of (d), if type $\bar{t}$ deviates to (a), then R_2 believes it comes from $\bar{t}$, which supports the equilibrium.

Q.E.D.

Notice that the belief structure off-the-equilibrium path is quite different between public and private disclosure. If a defection comes in public, the receivers' beliefs should be the same in public communication. However if a defection comes in private, each receiver can have different beliefs, since each player can have a different information set after that defection.

Now we consider the case $\alpha > 1$.

***Lemma* 1**

If a non-empty set of types use (e), then a non-empty set of types uses (a).

Proof: Suppose set (e) is not empty and set (a) is empty. Then set (e) is of the form $[t_e, \bar{t}]$, that is, $t_a = \bar{t}$ by emptiness of set (a). However $\bar{t}$ always deviates to (a), which contradicts the hypothesis.

Q.E.D.

***Lemma* 2**

If a non-empty set of types use (d), then no type uses (b).

Proof: Either one of (c) and (d) is empty or $y_1 + y_2 = y_p$. Suppose both set (d) and (b) are not empty. then set (c) must be empty since $y_1 + y_2 \neq y_p$. Furthermore set (b) should be of the form $[0, t_b]$, which gives $\mu_1 < t_b < \mu_p$. Then the boundary type of t_b deviates to (d).

Q.E.D.

By Lemma 1 and 2 there are three possible cases with (d), which are

1) (d) only

2) (d) and (a)

3) (d), (e)) and (a)

Without (d), the possible equilibrium strategies of commitment are same as that of no-commitment.

***Proposition* 5 (Commitment Equilibrium).**

Type A

1) If $\bar{t} < 2c/(\alpha - 1)$, then S chooses (d).

2) If $2c/(\alpha - 1) \le \bar{t} < 4c/(\alpha - 1) + 2c$,

$$\text{then } S \text{ chooses } \begin{cases} \text{(a) if } t \ge (\bar{t} + 2c)/\alpha \\ \text{(d) otherwise} \end{cases}$$

3) If $\bar{t} \ge (4c/(\alpha - 1)) + 2c$,

$$\text{then } S \text{ chooses } \begin{cases} \text{(a) if } t \ge \bar{t} - 2c \\ \text{(e) if } 4c/(\alpha - 1) \le t \le \bar{t} - 2c \\ \text{(d) otherwise} \end{cases}$$

Type B (same as no-commitment equilibrium)

1) If $\bar{t} \le 2c/\alpha$, then S chooses (c).

$$\text{2) If } 2c/\alpha < \bar{t} < 2c, \text{ then } S \text{ chooses } \begin{cases} \text{(a) if } t \ge 2c/\alpha \\ \text{(c) otherwise} \end{cases}$$

$$\text{3) If } 2c \le \bar{t} \le (2c/\alpha) + 2c, \text{ then } S \text{ chooses } \begin{cases} \text{(a) if } t \ge 2c/\alpha \\ \text{(c) if } \bar{t} - 2c \le t < 2c/\alpha \\ \text{(b) otherwise} \end{cases}$$

$$\text{4) If } (2c/\alpha) + 2c < \bar{t}, \text{ then } S \text{ chooses } \begin{cases} \text{(a) if } t \ge \bar{t} - 2c \\ \text{(e) if } 2c/\alpha \le t < \bar{t} - 2c \\ \text{(b) otherwise} \end{cases}$$

Proof:

Proof of Type A:

Proof of Case 1): By Lemma 1 and 2, it is sufficient to check to the deviation to (a). The payoff from deviation to (a) is $\alpha t - c + \bar{t} - \mu_2$, which is strictly increasing in t. Therefore if the sender type of $\bar{t}$ has no incentive to deviate to (a), then the equilibrium is supported.

the payoff from defection to (a): $\alpha t - c + \bar{t} - \mu_2$ where $\mu_2 = \bar{t}$

the equilibrium payoff from (d): $(\alpha - 1)\mu_p + \bar{t}$ where $\mu_p = \bar{t}/2$

From the above, we get the condition of $\bar{t}$, which is $\bar{t} \le 2c/(\alpha - 1)$.

Proof of Case 2): The sender type of t_a should be indifferent between sending (a) and (d), which gives $t_a = (\bar{t} + 2c)/\alpha$

the payoff from (a): $\alpha t_a - c + \bar{t} - \mu_2$ where $\mu_2 = (\bar{t} + t_a)/2$

the payoff from (d): $(\alpha - 1)\mu_p + \bar{t}$ where $\mu_p = \bar{t}_a/2$

The condition of $t_a \le \bar{t}$ give $\bar{t} \ge 2c/(\alpha - 1)$.

Now we want to check to the deviation to (e). The payoff from (e) – (d) is strictly increasing in t and that of (e) – (a) is decreasing in t. Therefore it is sufficient to find the condition that the sender type t_a has no incentive to deviate. This gives $t_a \le 4c/(\alpha - 1)$. The condition $t_a \le \bar{t}$ give $\bar{t} \le 4c/(\alpha - 1) + 2c$.

Proof of Case 3): The sender type of t_a should be indifferent between sending (a) and (e), which gives $t_a = \bar{t} - 2c$. The sender type of t_e should be indifferent between sending (e) and (d), which gives $t_e = 4c/(\alpha - 1)$.

The condition of $t_e \leq t_a \leq \bar{t}$ gives $\bar{t} \geq 4c/(\alpha - 1) + 2c$.

Proof of Type B:
We want show that any no-commitment equilibrium can be commitment equilibrium in the sense of Kreps and Wilson. Fix a no-commitment equilibrium. It is sufficient to check the deviation to (d), since any other deviation is already considered in no-commitment. Let the sender's belief from (d) be $\underline{t}$, which support the equilibrium.

Q.E.D.

There are multiple equilibria in this model, which is popular in signaling literature. We choose type A commitment equilibrium for the analysis of welfare comparison, since type B equilibrium is same as no-commitment equilibrium.

The type A commitment equilibrium does not include strategy (b) at all, i.e., no S type discloses to R_2 only. Furthermore some types do not send verifiable messages provided the cost of disclosure is positive. This result is really different from that of the no-commitment model. In the no-commitment model, every type must disclose to at least one of the audiences. This is because the lowest type does not have any incentive to verify to R_2 in the commitment model, since by choosing (d) he can always get at least the same payoff without incurring the cost of disclosure. The strategy (d), however, is not feasible in the no-commitment model since the sender can communicate publicly and also privately. This is the main difference between the two models.

Now we consider welfare implications. Define the sender's ex-ante expected utility as EV and the receiver R_i's expected utility as EU^i. That is,

$$EV = E[y_1 + y_2 - c(m(t))]$$
$$EU^i = \int_{t \in NV} u^i(y_i, t)f(t)dt + \int_{t \in V} u^i(y_i, t)f(t)dt,$$

where $i = 1, 2$ and NV and V are partitions of the set of non-verifiable messages and verifiable messages in equilibrium respectively.

Lemma 3
1) The ex-ante expected utility for the sender is decreasing when the range of verifiable message is increasing.
2) The ex-ante expected utility for the receiver is increasing when the range of verifiable message is increasing.

Proof:

Proof of 1): The sender's ex-ante expected utility, EV, consists of two components, the sum of expected responses and the expected cost of disclosure. The sum of expected responses is constant for any equilibrium since any linear combination of each mean is the same as the original mean by uniform distribution.

That is,

$EV = (\alpha - 1)\bar{t}/2 + \bar{t} - EC$ where EC is the expected cost of disclosure.

Therefore EV depends EC only.

Proof of 2): It is obvious from the utility function of receiver. That is, from equation (2) and (3) each receiver prefers less uncertainty on the type of sender.

Q.E.D.

Lemma 4

1) EU^1 with private disclosure only is at least as large EU^1 with public disclosure only.

2) If $\alpha > 3$, EU^2 with private disclosure only is smaller than as EU^2 with public disclosure only.

If $\alpha = 3$, EU^2 with private disclosure only is same as EU^2 with public disclosure only.

If $\alpha < 3$, EU^2 with private disclosure only is larger than EU^2 with public disclosure only.

Proof:

Proof of 1): By Lemma 3, it is sufficient to check the region of verifiable message to R_i in equilibrium.

The region of verifiable message to R_1 in private disclosure only is larger than that of public disclosure only since $2c/\ \alpha < 4c/(\alpha - 1)$. (See Proposition 1 and 2)

Proof of 2): If $\alpha > 3$, then $4c/(\alpha - 1) < 2c$. Therefore the verifiable region to R_2 in public is larger than that with private disclosure only.

Q.E.D.

Lemma 4 shows that players' welfares are influenced by the presence of the other audience, since the model with private disclosure only is the same as two single-audience models. The results show that R_1 is worse off by the presence of R_2 since S has the reverse relationship with R_2. Similarly there is the same effect to R_2. However R_2 can be better off with large α. This is because if α is large, then the set of disclosure can be larger by giving much weight on R_1.

Proposition 6

The sender's ex-ante expected utility in commitment equilibrium is at least as large that of any no-commitment equilibrium.

Proof: It is sufficient to compare between type A commitment equilibrium and no-commitment equilibrium. Fix $\bar{t}$ and compare the region of verifiable messages in equilibrium. Then the range of verifiable messages in type A is not larger than that of no-commitment equilibrium.

Q.E.D.

Proposition 6 shows that by convincing the public that he "keeps silent", which is the strategy (d), the sender can be better off. This is feasible only with commitment.

Our model can be interpreted as follows:

If receivers communicate the information of messages, then this model is same as the model of public disclosure only except the cost of disclosure. In public disclosure, sender has to pay $2c$ for the cost of public disclosure. However if receivers communicate the message, sender sends the verifiable message only one receiver, which reduces the cost of disclosure by half. Therefore it the cost of public disclosure is c, then two models coincide.

If receivers communicate whether message is sent or not only, then this model is same as type A commitment model. Notice that in type A equilibrium, one receiver knows whether the other receiver gets sender's message or not. However he does not observe the true type of sender if he gets no message.

Finally if receiver can not communicate at all, then this model is same as no-commitment model.

IV. Conclusion

We have investigated the sender's choice of forum in equilibrium. The equilibrium is influenced by the receivers' strategic inferences not only from the message but also from the choice of forum. The results are very sensitive to whether S can commit to one forum or not. In a no-commitment equilibrium, every sender type must send a verifiable message to at least one audience when the cost of disclosure is small. However with commitment some sender types do not send verifiable messages provided the cost of disclosure is positive. The difference arises because by choosing the public disclosure, the sender can commit himself not to communicate privately to each audience in the commitment model. Therefore the sender can make a claim not to talk privately only in the commitment model.

The presence of the other audience also affects welfare. By the presence of the other audience, one audience may be worse off since the relationship between the sender and one receiver is reverse to that of the sender and the other receiver. However in public disclosure less important audience for the sender can be better off by the presence of the other audience.

Finally the difference between no-commitment and commitment model can be explained by relaxing the possibility of communication between the receivers. If the receivers communicate whether he gets message or not (not telling the true type of sender), then we have type A commitment equilibria. Otherwise we have no-commitment equilibria. However we do not consider the strategic behaviors of information transmission between receivers, which will be future research.

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