Message-Contingent Delegation*

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Abstract

The paper studies the role of delegation and authority in a principal-agent relation in which a non-contractible action has to be taken. The agent has private information relevant for the principal, but has policy preferences different from the principal. Consequently, an information revelation problem arises. We consider a partially incomplete contracting environment with contractibility of messages and decision rights and with transferable utility. We contribute to the literature by allowing for message-contingent delegation and by deriving the optimal partially incomplete contract. It is shown that message-contingent delegation creates incentives for information revelation and may outperform unconditional authority and unconditional delegation.

Keywords: Delegation, Mechanism Design, Imperfect Commitment, Transferable Utility

JEL Classification: C72, D82, L22

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1 Introduction

Decision making in firms and organizations typically affects different members in different ways. At the same time, the information relevant for decision making is often widely spread through the organization. A conflict arises if those in charge of the decision have policy preferences different from those who hold the relevant information.

An example is installing a new production technology (e.g. computers) in a firm. The employer may prefer the technology suited best for a given task but may not know the best technology. In contrast, the worker, being an expert, may privately know the best technology but may prefer technologies that enhance only his private benefit from working (e.g. flat screens etc.). Another example is a principal who hires an agent who is spezialized in a particular project where only the agent knows his specialization. While the principal may prefer projects in which the agent is specialized, the agent may rather prefer prestigous projects or projects that improve his human capital.

The general problem is one of communication. An agent may be unwilling to reveal relevant information so as to prevent the principal from pursuing a policy contrary to his private interests. The problem is particularly severe when the principal cannot credibly pre-commit not to take an action detrimental to the agent. Indeed, it is well known from the cheap talk literature that the commitment problem generally prevents the principal from making a decision in which all of the agent's information is used (see *Crawford/Sobel* (1982)[1]).

If the principal cannot commit to an action, a simple way to use the agent's information is to decentralize decision making away from the principal to the agent.[2] However, by giving away control, the principal may be hurt by the agent's discretion. This trade-off between loss of information and loss of control is the basis for an extensive discussion of the information

[1] For a review of the cheap talk literature see *Farrell/Rabin* (1996). For two recent contributions see *Krishna/Morgan* (2000) and *Battaglini* (2002).

[2] If the principal *can* commit to an action, the classical revelation principle implies that the outcome of delegation can be implemented through a complete incentive compatible contract in which the principal has control over the action (see *Holmström* (1984), *Szalay* (2003)).

revelation problem both in political science[3] and in economics[4]. The general lesson from this literature is that if differences in policy preferences are not too large, the informational benefits of delegation may outweigh the benefits of control under cheap talk.

While cheap talk models capture situations in which contracts essentially cannot be written, this paper considers the communication problem when contracts are only partially incomplete. Particularly, we consider a situation where, on the one hand, the principal's commitment is limited by non-contractibility of actions, but, on the other hand, messages from the agent to the principal and decision rights are contractible. We refer to *authority* when the principal has the decision right and to *delegation* when the agent has that right. Since decision rights and messages are contractible, the principal can transfer control on a contingent basis, depending on a report by the agent. We call this case *contingent delegation*.

In this contracting environment, delegation serves three purposes: first, as the agent always benefits from delegation, it facilitates participation of the agent. Second, as in environments with non-contractible messages, it is a cheap way to make use of the agent's information. Finally and most interestingly, by rewarding the agent by delegation, contingent delegation provides the principal with an additional instrument to structure the agent's incentives to reveal information.

The optimal contract trades off these benefits of delegation against the costs accompanied by loss of control. The contribution of the paper is to find and analyze the optimal contract.[5] The difficulty in doing so stems from the principal's limited commitment. For with imperfect commitment, the standard revelation principle generally fails, as the principal will not comply with the (non-verifiable) contract provisions when the agent reveals his information truthfully.

To take into account imperfect commitment, we apply a generalized version of the revelation principle as developed in *Bester/Strausz* (2001). Bester/Strausz show that for a principal with imperfect commitment the best contract, as with the classical revelation principle, is still a direct contract, that is, the message space coincides with the state space. But as opposed to

[3] This literature asks whether a legislature should adopt an open rule (authority) or a closed rule (delegation) when it consults specialized commitees. See for example *Gilligan/Krehbiel* (1987, 1989), *Austin-Smith* (1990, 1993), *Epstein* (1998), *Krishna/Morgan* (2001). For a review see *Bendor/Glazer/Hammond* (2001).

[4] See for example *Aghion/Tirole* (1997), *Garidel-Thoron/Ottaviani* (2000), *Dessein* (2002).

[5] We restrict attention to mechanisms with one-shot face-to-face communication. We therefore refer to the optimal contract as the optimal contract in this restricted class. However, the principal can possibly improve by using more general mechanisms, e.g., with a mediator (see *Myerson* (1991), chapter 6.7, or *Mitusch/Strausz* (1999, 2000)) or with back-and-forth face-to-face communication (see *Forges* (1995)).

the classical revelation principle, it may be optimal for the principal to induce the agent to lie with positive probability. That is, fully revealing contracts need no longer be optimal.

We shall consider a setup with two agent types who differ in their willingness to pay to avoid a decision by the principal. We call the type who suffers more from the principal's discretion compatible and the other type incompatible. Our main result is that contingent delegation may be optimal, as under contingent delegation, incentive compatibility can be achieved with lower transfers than under authority. The reason is as follows. To guarantee participation of the compatible type under authority, he has to be compensated for the loss the principal inflicts on him by her decision. But since the incompatible type's loss from that decision is smaller than the compatible type's, the incompatible type obtains a positive gain when he pretends to be compatible. Accordingly, under authority the incompatible type has to be paid an information rent to prevent him from lying.

This changes if the decision is delegated to the compatible type. This is because when the agent has the decision right, he chooses, irrespective of his type, an action that inflicts no loss on him. Hence, both types obtain the same utility from the decision upon announcing to be compatible, and the incompatible agent is no longer "overcompensated" when lying . Therefore, no rent has to be paid for the incompatible agent, and incentive compatibility is achieved with lower monetary transfers.

However, contingent delegation is also costly, as one agent type is granted discretion. So the balance depends on the size of the delegation costs. If the prinicipal's interest in the decision is not too large, delegation costs are moderate, and contingent delegation becomes optimal.

Related Literature

Our paper is most closely related to the literature that studies the abovementioned information revelation problem. Closest to our setup are the papers by *Dessein* (2002), *Garidel-Thoron/Ottaviani* (2000), and *Baron* (2000). The main difference to that literature is that we consider partially incomplete contracts and derive the optimal contract for a richer class of contracts including only partially revealing contracts with contingent delegation.

More precisely, unlike us Dessein focuses on pure cheap talk with non-transferable utility and assumes that control can be transferred on a non-contingent basis only. Also Garidel-Thoron/Ottaviani do not allow for contingent delegation, but as we they do consider monetary transfers. Yet, they restrict the class of feasible contracts to contracts that fully reveal the agent's type. In contrast, we allow for contracts that only partially reveal the agent's type since with limited commitment fully revealing contracts need not be optimal.

Baron, in a political science context, also considers monetary transfers, but his notion of delegation differs from ours. In his approach, the agent may or may not propose a policy. Under authority (open rule), the principal chooses an action by discretion after the agent' proposal. Under delegation (deference), the principal is committed to enact the proposal, while if no proposal is made, the principal chooses an action by discretion. Baron shows that deference generally dominates open rule, but he does not derive the optimal contract.

Similar to us, also *Aghion et al.* (2002) study partially incomplete contracts and allow for message-contingent control allocations. The main difference is that they consider a two-stage scenario where the principal can delegate control only in the first, the project design stage but not in the second, the implementation stage where she can always stop the project. As with us, message-contingent control allocations may be optimal, but the reason is different. In Aghion et al., control is delegated upon announcement of a "bad" type, as in doing so this type is rewarded to reveal himself and the principal can stop the project. In our case, control is delegated to the compatible type so as to reduce the reward from lying for the other type.

Delegation helps to reveal information also in *Gautier/Paolini* (2002). They consider a setup with repeated decisions. Letting the agent choose at early stages may reveal information that can be used by the principal if he retains control over later choices.

Our model is also related to the literature in which the allocation of authority interacts with the agent's optimal effort choice.[6] In contrast to these papers, in our model the agent's choice of action (under delegation) is independent from the allocation of authority.

The information revelation problem is also studied by *Mitusch/Strausz* (1999, 2000). Rather than on delegation, they focus on mediation where there is a mediator who communicates with the agent and afterwards makes a policy proposal to the principal.

The paper is organized as follows. Section 2 describes the model. In section 3 the optimal contract is derived. Section 4 discusses the robustness of our results. In particular, we shall comment on the assumption of contractible communication and on renegotiation proofness. Section 5 concludes.

[6] See for example *Aghion/Tirole* (1997), *Baker/Gibbons/Murphy* (1999), *Bester* (2002).

2 The Model

A principal, P (she), hires an agent, A (he), to work on a project. P's and A's payoff from a project depends on some action y that is (irreversibly) chosen before the project is actually conducted.[7] E.g., y may represent the technology A has to use. Actions can be chosen either by P or by A, but only A is able to work on the project. We assume that $y \in Y = \mathbb{R}$.

In addition, payoffs depend on a state of the world, t. E.g., A may be suited better or worse to work with a particular technology. We assume that there are two states of the world, $t_0 = 0$ and $t_1 = 1$, with ex-ante probabilities γ_0 and γ_1, respectively.

A has perfect private information about the true state while P is entirely ignorant. (So A is an expert.) We identify the state with an agent's type and denote an agent of type t by A_t.

Payoffs from projects are as follows. If in state t action $y \in Y$ is taken, P's and A's utility—gross of potential transfers—are respectively given as

$$v(y,t) = -\lambda (y-t)^2, \tag{1}$$

$$u(y,t) = -(y-(t+b))^2. \tag{2}$$

The parameter $b \geq 0$ is called *bias*. The larger is b, the more differ the parties' preferences with respect to action $y \in Y$. The parameter $\lambda > 0$ captures the idea that decisions may affect players differently and is called P's *interest* relative to A's. If $\lambda > 1$, deviations from a player's most preferred action entail more serious losses for P than for A. If $\lambda < 1$, the reverse holds. Throughout we assume that *utility is transferable.*

Most Preferred Actions

P's most preferred action in state t is $y_t^P = t$, and A_t's most preferred action is $y_t^A = t + b$. Notice that A_1 prefers y_1^P to y_0^P. So if P had the decision right and was naive such that she believed any reports sent by the agents, A_1 would not want to lie. We call an agent with this property *compatible*[8]. Formally, A_t is compatible if and only if $u\left(y_t^P, t\right) \geq u\left(y_s^P, t\right)$ for $t \neq s$.

Note that compatibility of A_0 depends on b. Indeed, A_0 is compatible if and only if $b \leq 1/2$. The communication problem arises if A_0 is not compatible. In this case, if P had the decision right and was naive, A_0 would pretend to be A_1.

[7] A has no discretion when working on the project, that is, there is no ex-post moral hazard.

[8] This term is borrowed from *Mitusch/Strausz* (1999).

Contracts and Decision Rights

Disaligned preferences together with asymmetric information give rise to the mentioned conflict between P and A. To mitigate the conflict, parties write an explicit contract.

We assume contracts to be partially incomplete. More specifically, we assume that actions are non-contractible. By contrast, decision rights and monetary transfers are contractible. Moreover, the assignment of the decision right and payments can be made contingent on messages sent from A to P, that is, we assume contractibility of messages.[9]

Specifically, the contracting game is as follows. P designs a message space M and offers A a contract $\Gamma = (M, \alpha_m, w_m)$. If A accepts, he sends a message $m \in M$ to P. Then, contingent on message m, P either delegates the decision or not. If $\alpha_m = 1$, P chooses an action. If $\alpha_m = 0$, A chooses an action.[10] Finally, P pays A a contingent transfer w_m.

If A rejects, the project cannot be conducted, and both players receive their reservation utility.[11] We normalize A's reservation utility to 0. P's reservation utility is $\overline{v} \in \mathbb{R}$. The size of $\overline{v}$ reflects benefits from trade: the smaller is $\overline{v}$, the higher are the benefits from trade.

Remark: The size of $\overline{v}$ determines whether P benefits from the relation at all. If $\overline{v}$ is large, the best P can do is to offer a contract that is rejected by both agent types. If $\overline{v}$ is moderate, P may optimally screen between the agents by making an offer that is rejected by exactly one agent type. To illustrate, consider the contract that offers a wage b^2 and gives P the decision right. It is easy to see that it is an equilibrium that A_1 rejects and A_0 accepts. This contract gives P expected utility $-\gamma_0 b^2 + \gamma_1 \overline{v}$. However, if $\overline{v}$ is small, this can never be optimal since P can guarantee herself a payoff of at least $-\lambda b^2$ by unconditionally delegating the decision and paying a wage of 0. We therefore assume in the sequel that $\overline{v} \leq -\lambda b^2$. This makes sure that P will optimally make offers that are accepted by both agent types.

[9] We shall comment on this assumption in more detail in section 4.

[10] The restriction to deterministic assignments $\alpha \in \{0, 1\}$ is made for computational simplicity.

[11] This assumption is similar to *Aghion et al.* (2002). In contrast, *Dessein* (2002) and *Baron* (2000) assume that P can choose an action without A's consent. This is appropriate if, e.g., A provides only pure advice but is not needed to work on the project.

3 Delegation and Authority

Before characterizing the optimal incomplete contract of the form $\Gamma = (M, \alpha_m, w_m)$, we shall first consider the case with contractible actions.

3.1 Benchmark: The Complete Contract with Perfect Commitment

If the action is contractible, P can in particular commit to the action A would take if he had the decision right. Hence, any contract with delegation can as well be implemented by a contract in which P keeps control. Thus, without loss of generality, $\alpha_t = 1$.

Moreover, we can apply the classical revelation principle. P's problem writes

$$\max_{y,w} \sum_{t\in\{0,1\}} \left[-\lambda\left(y_t - t\right)^2 - w_t\right]\gamma_t \qquad \text{s.t.}$$

$$\text{IC}_t : -\left(y_t - (t+b)\right)^2 + w_t \geq -\left(y_s - (t+b)\right)^2 + w_s \qquad \text{for } t \neq s \tag{3}$$

$$\text{IR}_t : -\left(y_t - (t+b)\right)^2 + w_t \geq 0. \tag{4}$$

Here, y_t and w_t denote message-contingent actions and transfers (wages), respectively. The solution of the program is as follows. The proof is in the appendix.

Proposition 1 *Define*

$$\widehat{b} = \frac{1+\lambda}{2\lambda}, \quad \widetilde{b} = \frac{2+\gamma_1(\lambda-1)}{2\gamma_1\lambda}, \tag{5}$$

and let I be the indicator function. Then with perfect commitment optimal actions are given by

$$y_0 = \frac{b}{1+\lambda}, \tag{6}$$

$$y_1 = \left(1 + \frac{b}{1+\lambda}\right) I_{\left(b\leq\widehat{b}\right)} + \left(\frac{1}{2} + b\right) I_{\left(\widehat{b}<b\leq\widetilde{b}\right)} + \left(\frac{\gamma_1\lambda+1}{\gamma_1(1+\lambda)} + \frac{b}{1+\lambda}\right) I_{\left(b>\widetilde{b}\right)}. \tag{7}$$

Furthermore, A_1 gets just his reservation utility and A_0 gets an information rent if b is sufficiently large, that is,

$$w_0 = (y_0 - b)^2 I_{\left(b\leq\widetilde{b}\right)} + \left[(y_0 - b)^2 + 1 + 2b - 2y_1\right] I_{\left(b>\widetilde{b}\right)}, \tag{8}$$

$$w_1 = \left(y_1 - (1+b)\right)^2. \tag{9}$$

The results exhibit familiar features of standard adverse selection models. There is no distortion at the top. That is, y_0 equals the efficient action under complete information. Also, agent A_1

is kept at his reservation utility. For small bias ($b \leq \widehat{b}$) also y_1 equals the efficient action, and also A_0 only gets his reservation utility. As b increases, it is no longer optimal to implement the efficient action in state 1 since this can only be done at the price of a large w_0 so as to ensure incentive compatibility for A_0. Rather, it is cheaper to provide incentives for A_0 by deviating from the efficient action in state 1 and to pay agent A_0 a smaller information rent.

3.2 The Incomplete Contract with Imperfect Commitment

If P cannot commit to an action ex ante, the classical revelation principle fails. This is because A anticipates that P, under authority, will use her discretion and thereby hurt A if he reports his type truthfully. So the contract of Proposition 1 is no longer feasible. To find the optimal contract, we can apply a generalized version of the revelation principle of *Bester/Strausz* (2001). As shown there, the optimal contract is still a direct contract. That is, $M = \{0, 1\}$. A contract Γ then induces a Bayesian game with the following strategies and payoffs.

Strategies: A's strategy consists of a probability distribution over messages and an action if the decision is delegated. For $s, t \in \{0, 1\}$ let $\sigma_{st} = P\left[m = s \,|\, A_t\right]$ be the probability that A_t sends message $m = s$. Moreover, let $y_t^A \in Y$ be A_t's action in case of delegation.

P's strategy is a function that maps messages into actions. For $s \in \{0, 1\}$ let $y_s \in Y$ be P's action contingent on having received message $m = s$. Moreover, P holds a belief about the state of nature conditional on the message received. Let $\mu_{ts} = P\left[A_t | \, m = s\right]$ be P's belief that A is of type t conditional on having received message $m = s$.

Payoffs: For given $\Gamma = (\alpha_t, w_t)$ and strategies $\left(\sigma_{st}, y_t^A\right)$, y_s the principal receives message s in state t with probability $\gamma_t \sigma_{st}$. In this case, she obtains gross utility $-\lambda \left(y_s - t\right)^2$ if $\alpha_s = 1$, and $-\lambda \left(y_t^A - t\right)^2$ if $\alpha_s = 0$. Furthermore, she pays A transfer w_s. So P's expected utility is

$$V = \sum_{t,s \in \{0,1\}} \gamma_t \sigma_{st} \left[\alpha_s \left(-\lambda \left(y_s - t\right)^2\right) + (1 - \alpha_s) \left(-\lambda \left(y_t^A - t\right)^2\right) - w_s\right]. \tag{10}$$

Likewise, A_t's expected utility from sending message $m = s$ is given by

$$U(s; t) = \alpha_s \left(-\left(y_s - (t + b)\right)^2\right) + (1 - \alpha_s) \left(-\left(y_t^A - (t + b)\right)^2\right) + w_s. \tag{11}$$

In a Perfect Bayesian Nash Equilibrium, actions have to be optimal given beliefs. Accordingly, whenever the decision is delegated, A_t chooses his most preferred action $y_t^A = t + b$. Thus,

$$V = \sum_{t,s\in\{0,1\}} \gamma_t \sigma_{st} \left[\alpha_s \left(-\lambda \left(y_s - t\right)^2\right) + \left(1-\alpha_s\right)\left(-\lambda b^2\right) - w_s\right], \tag{12}$$

$$U\left(s;t\right) = \alpha_s \left(-\left(y_s - \left(t+b\right)\right)^2\right) + w_s. \tag{13}$$

As A anticipates that P will use revealed information in a way detrimental to A, it might be very expensive for P to induce truthful revelation. It may thus be optimal to let A misrepresent his type with positive probability. In this case, A has to be kept indifferent between messages. Formally, the generalized revelation principle states that the optimal contract for P is the solution to the following program.

$$\max_{\sigma,y,\alpha,w} V \qquad \text{s.t.}$$

$$\text{IC}_t: \quad U\left(t;t\right) \geq U\left(s;t\right) \qquad \text{for } t \neq s \tag{14}$$

$$\text{IR}_t: \quad U\left(t;t\right) \geq 0 \tag{15}$$

$$\text{IND}: \quad \left[U\left(t;t\right) - U\left(s;t\right)\right]\sigma_{st} = 0 \quad \text{for } \sigma_{st} \in (0,1) \tag{16}$$

$$\text{OPT}: \quad y_s \in \arg\max_y \sum_{t\in\{0,1\}} \mu_{ts}\left[-\lambda\left(y_s - t\right)^2\right] \tag{17}$$

$$\text{BayR}: \quad \mu_{ts} = \frac{\sigma_{st}\gamma_t}{\sigma_{st}\gamma_t + \sigma_{ss}\gamma_s} \tag{18}$$

Conditions IC and IR are the usual incentive compatibility and (interim) individual rationality constraints[12]. The three additional constraints account for limited commitment. Condition IND says that A has to be indifferent between messages if he actively mixes between messages. Moreover, in a Perfect Bayesian Equilibrium, P must choose an optimal action given her beliefs, and these beliefs must be derived by Bayes rule, given A's strategy. These are conditions OPT and BayR. Notice that OPT implies $y_s = \mu_{1s}$.

P has two instruments to induce information revelation and participation: wages and decision rights. Raising w_t or reducing α_t, ceteris paribus, increases the incentive to report message $m = t$ and the participation incentive of agent A_t. The two instruments are accompanied with different costs. Raising w_t increases the wage bill. Transfering the decision right leads to a suboptimal action for P. The costs of transfering the decision right are reflected by the term $\left(1-\alpha_s\right)\left(-\lambda b^2\right)$ in P's objective. The larger is λ, the larger are delegation costs.

[12] Following *Garidel-Thoron/Ottaviani* (2000), the interim individual rationality constraint can be interpreted as limited liability of the agent. Ex-ante individual rationality constraints are similarly dealt with.

Before characterizing the optimal contract, notice first that for $\lambda \leq 1$, P optimally unconditionally delegates the decision. This is because if P retains control, she has to pay the wage b^2 at least to one agent type to guarantee participation. Yet, delegating the decsion to this type gives her a payoff of $-\lambda b^2 \geq -b^2$.

Assume now that $\lambda > 1$. In this case, P's utility is bounded from above by $-b^2$. To see this, suppose A was honest and reported his type truthfully even if incentive constraints would not hold. This could only improve P's utility. To ensure participation, P would then optimally set $y_t = t$ and $w_t = \alpha_t b^2$ for given α. The resulting utility for P would be

$$\overline{V} = -\gamma_0 \alpha_0 \cdot 0 - \gamma_0 (1 - \alpha_0) \lambda b^2 - \gamma_0 w_0 - \gamma_1 \alpha_1 \cdot 0 - \gamma_1 (1 - \alpha_1) \lambda b^2 - \gamma_1 w_1 \tag{19}$$

$$= -\lambda b^2 - b^2 (1 - \lambda) (\gamma_0 \alpha_0 + \gamma_1 \alpha_1). \tag{20}$$

Hence, for $\lambda > 1$, α is optimally set to $\alpha_0 = \alpha_1 = 1$, resulting in an upper bound $\overline{V} = -b^2$.

The upper bound is assumed under unconditional authority when both A's are compatible:

Proposition 2 *Let $\lambda > 1$ and $b \leq 1/2$. Then unconditional authority is optimal. That is, the optimal contract has $\alpha_0 = \alpha_1 = 1$ and $w_0 = w_1 = b^2$. P's expected utility is $V(1,1) = -b^2$.*

Proof: We show that $y_0 = 0, y_1 = 1$ is an equilibrium for $\Gamma = (\alpha, w) = (1, b^2)$. Indeed, since $b \leq 1/2$, both incentive constraints IC_t hold with strict inequality for $y_0 = 0, y_1 = 1$. Thus, by IND, $\sigma_{00} = \sigma_{11} = 1$, and by OPT and BayR, $y_0 = 0, y_1 = 1$. Moreover, P receives $u(y,t) = 0$ and pays b^2 in either state. Thus, $V = -b^2 = \overline{V}$. $\square$

The intuition for the case $\lambda \leq 1$ or $b \leq 1/2$ is simple. If $b \leq 1/2$, both agents are compatible and reveal their type without being paid an information rent. Delegation is thus exclusively motivated by participation considerations.[13]

If $b > 1/2$ and $\lambda \leq 1$, an incentive problem arises since A_0 becomes incompatible. Thus, if P retains control, she has to pay A_0 a rent to reveal information. By contrast, under delegation, P does not need to pay a rent. As λ is small, delegation costs are small, and delegation is a cheap way to make use of A's information.[14]

We now characterize the optimal contract for the remaining parameters $b > 1/2$ and $\lambda > 1$. For this, we define

$$\widehat{\lambda}(b) = 1 + \frac{\gamma_0}{\gamma_1} \frac{2b - 1}{b^2}. \tag{21}$$

[13] That delegation facilitates participation is also pointed out in *Aghion/Tirole* (1997), section IV.B.

[14] This effect is at the core of *Dessein* (2002), and *Garidel-Thoron/Ottaviani* (2000).

Proposition 3 *Let $b > 1/2$ and $\lambda > 1$.*

(i) Let $\lambda \geq \widehat{\lambda}$. Then unconditional authority is optimal. Agent A_0 receives an information rent of $2b-1$ and agent A_1 gets his reservation utility, that is, $w_0 = b^2 + 2b - 1$ and $w_1 = b^2$. P's expected utility is

$$V(1,1) = -b^2 - \gamma_0 (2b-1). \tag{22}$$

(ii) If $\lambda < \widehat{\lambda}$, then contingent delegation is optimal where the decision is delegated contingent on announcement of type $t = 1$. That is, $\alpha_0 = 1, \alpha_1 = 0$. Moreover, no agent receives an information rent, that is, $w_0 = b^2$ and $w_1 = 0$. P's expected utility is

$$V(1,0) = -\gamma_0 b^2 - \gamma_1 \lambda b^2. \tag{23}$$

The proof is in the appendix. The proof also shows that it is always optimal for P to induce perfect truthtelling.[15] So if P has the decision right, she implements her most preferred action.

Proposition 4 *Irrespective of b and λ, P optimally induces A to report truthfully and chooses the corresponding action under authority, that is, $\sigma_{00} = \sigma_{11} = 1$, and $y_0 = 0, y_1 = 1$.*

Figure 1 portrays the optimal contract in b-λ-space.

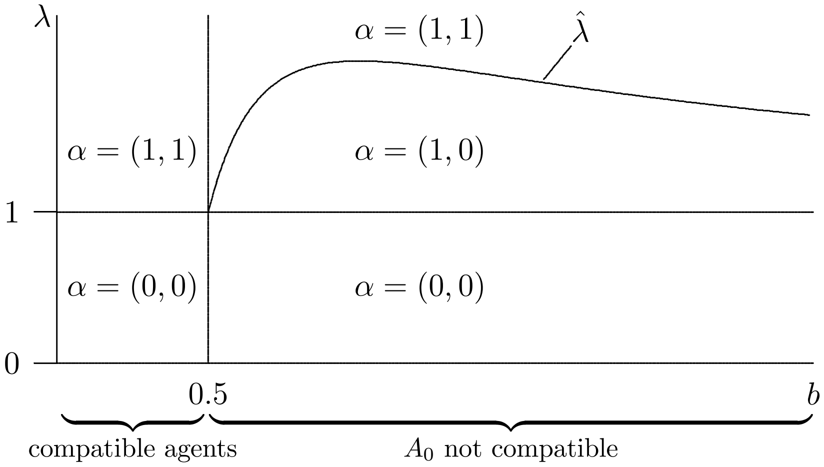

Figure 1: Decision Rights, Interest, and Bias

To understand better the role of contingent delegation for $\lambda > 1, b \geq 1/2$, it is helpful to compare (unconditional) authority and contingent delegation contingent on sending message

[15] This results from the assumption that both interest and bias are state-independent. If this is relaxed, the computational effort rises considerably.

$m = 1$. Under authority, A_1 has to be compensated only for the loss P's action inflicts on him but, due to compatibility, has not to be paid a rent to prevent him from lying. Hence, by delegating the decision contingent on $m = 1$, the transfer to A_1 can be reduced by exactly the loss P's choice under authority inflicts on him (equal to b^2) and this leaves him with the same truthtelling incentives as under authority.

Consider now the incompatible agent A_0. The crucial observation is that under authority A_0's loss from the decision P makes upon receiving $m = 1$, is less than A_1's loss from that decision. In other words, A_0's willingness to accept P's decision is lower than that of A_1. Hence, when pretending to be A_0, A_1 is "overcompensated" for the loss inflicted by the decision and makes a positive gain. Thus, he needs to be paid a rent for not lying.

This is no longer so when P delegates control upon receiving $m = 1$. In this case, A_0's loss from sending $m = 1$ is the same as A_1's loss from sending $m = 1$ (equal to 0). Hence, when pretending to be A_1, A_0 is not "overcompensated" and no rent has to be paid to A_1. So incentive compatibility is achieved with lower transfers than under authority.

The same argument explains why contingent delegation of the form $\alpha = (0, 1)$ does not help to reduce transfers in comparision to unconditional authority. If P keeps the decision right upon receiving $m = 1$, due to being hurt less by P's decision, A_0 has always to be given a rent to prevent him from lying.

In sum, contingent delegation of the type $\alpha = (1, 0)$ creates incentives for information revelation with lower transfers than does authority. It does so by exploiting the incompatible agent's lower willingness to accept a decision by P. However, it is also costly, as A_1 is granted the decision right. The balance depends on P's interest. For moderate interest, contingent delegation becomes optimal.

Note, the incentive effect requires both contractibility of messages and transferable utility. It is absent in cheap talk models as in *Dessein* (2002) and *Garidel-Thoron/Ottaviani* (2000).

Furthermore, it is interesting that for fixed λ with $1 < \lambda < \widehat{\lambda}$, there is no monotone relation between (unconditional) authority and (contingent) delegation for increasing b. This may appear surprising, as for fixed λ, P's loss under delegation increases in b, and it may seem that control should be in P's hands for larger bias. Yet, also the monetary transfers under authority rise in b since A's loss increases for larger bias, too. In particular, if A is equally interested in the decision as P, then it is never optimal for P to unconditionally keep control.

4 Discussion

In this section, we shall comment on the robustness or our results. As mentioned in footnote 5, our findings are valid only in the restricted class of one-shot face-to-face communication procedures. Extensions to more general procedures could be dealt with by applying extensions of the employed revelation principle as outlined in *Bester/Strausz* (2003).

Moreover, one might wonder what the point of verifiable messages is if additional communication between the parties cannot be precluded. Consider what would happen if A could amend his message after receiving the transfer but before decisions are taken. To illustrate, suppose unconditional authority is optimal and the incompatible agent receives an informaton rent. Suppose that both agent types first send the message that gives the highest transfer and then tell P, in private and unverifiably, that the message was meaningless. If P believed this and thus kept her prior, she would choose her optimal action $y_1 = \gamma_1$. If γ_1 is not too small, it can be seen that both agent types would have an incentive to indeed behave like this. The amended message would thus be credible, and P would have to believe it.[16]

To avoid such problems, we need to assume that P can commit to communicate with A exclusively through the pre-designed messages, for example, by shutting down any communication after the first message. This guarantees that P can select her best equilibrium.

A further issue is renegotiation. Note that if control is actually delegated under contingent delegation, both parties would benefit ex post if P re-acquired control from A (P's willingness to pay is λb^2 and A's willingness to accept is b^2). As above, shutting down ex post communication would mitigate this tension between ex ante incentives and ex post efficiency.

Apart from these conceptual issues, our results depend on the model specification that is made for tractability reasons. What drives the incentive effect of contingent delegation is that the compatible agent A_1 is hurt more by P's discretion than A_0. While such a situation does not seem unnatural, it need not to be satisfied, for example, with state-dependent bias or reservation utilities. Further, due to the two-type assumption there is no incentive problem for small bias. While this would change in a model with a continuum of types, we conjecture that a similar result would hold for all biases as in our case for large bias. Yet, it is not clear how the *Bester/Strausz* (2001) revelation principle carries over to a type continuum.

[16] In other words, the equilibrium is not neologism-proof (*Farrell* (1993)). We thank an anonymous referee for indicating this as well as the renegotiation issue (see below) to us.

The model raises some questions for future research. For example, it would be interesting how the control allocation affects information acquisition incentives for an initially uninformed agent. This would require to solve the model for three agent types, including one uninformed type whose search was unsuccessful.

A further extension concerns the number of agents. The *Crawford/Sobel* (1982) model has recently been extended to two agents (*Krishna/Morgan* (2000), *Battaglini* (2002)), and the comparison with delegation for non-transferable utility is investigated in *Krishna/Morgan* (2001). As for transferable utility however, the extension is not straightforward, as the generalized revelation principle need not hold for multiple agents (see *Bester/Strausz* (2000)).

5 Conclusion

The paper studies the role of delegation and authority within a principal-agent relation in which a non-contractible action has to be taken. The agent has private information relevant for the principal's best policy, but has policy preferences different from the principal. We analyze the information revelation problem under the assumption of transferable utility and contractibility of messages and decision rights and derive the optimal contract for the principal. This has not been thoroughly done in the literature and is therefore our main contribution.

Our results show that delegation serves three purposes. As in environments with non-contractible messages, delegation facilitates participation of the agent and may be a cheap way to make use of the agent's information. More interestingly, we show that contractibility of messages together with transferable utility give rise to an incentive effect. Contingent delegation creates incentives for information revelation in that it exploits the differences in the agent types' willingness to accept a decision by the principal.

Appendix

Proof of Proposition 1: Let $\Delta w = w_0 - w_1$. P's objective can then be written as

$$V = -\gamma_0 \lambda y_0^2 - \gamma_1 \lambda (y_1 - 1)^2 - \gamma_0 \Delta w - w_1. \tag{24}$$

The IC constraints can be written as

$$(y_0 - b)^2 - (y_1 - b)^2 \overset{\mathrm{IC}_0}{\leq} \Delta w \overset{\mathrm{IC}_1}{\leq} (y_0 - b)^2 - (y_1 - b)^2 + 2(y_1 - y_0) \tag{25}$$

Hence, IC_1 can be replaced by

$$\mathrm{IC}_1': \qquad y_0 \leq y_1 \tag{26}$$

This implies that w_1 can be reduced without violating the IC constraints. Thus, as w_1 enters V negatively, IR_1 must be binding. Hence, $w_1 = (y_1 - (1+b))^2$. Together with IR_0 this implies

$$\Delta w \geq (y_0 - b)^2 - (y_1 - (1+b))^2 = (y_0 - b)^2 - (y_1 - b)^2 + 2(y_1 - b) - 1. \tag{27}$$

As Δw enters V negatively, either this inequality or IC_0 must hold with equality. So

$$\Delta w = (y_0 - b)^2 - (y_1 - b)^2 + \max\{0, 2(y_1 - b - 1/2)\} \tag{28}$$

By inserting w_1 and Δw into V, P's problem reduces to maximize

$$- \gamma_0 \lambda y_0^2 - \gamma_1 \lambda (y_1 - 1)^2 - \gamma_0 (y_0 - b)^2 + \tag{29}$$

$$+ \gamma_0 (y_1 - b)^2 - \gamma_0 \max\{0, 2(y_1 - b - 1/2)\} - (y_1 - (1+b))^2 \tag{30}$$

subject to IC_1'. Ignoring IC_1' for a moment, the first order condition for y_0 yields $y_0 = b/(1+\lambda)$.

For y_1, since the objective has a kink in $y_1 = b + 1/2$, we need to distinguish the case $y_1 < b + 1/2$ (case A), and $y_1 \geq b + 1/2$ (case B). In case A, the first order condition yields

$$y_1^A = \frac{\gamma_1 (\lambda + b) + 1}{\gamma_1 (1 + \lambda)}. \tag{31}$$

Notice that $y_1^A < b + 1/2$ if and only if $b > (2 + \gamma_1 (\lambda - 1)) / (2\gamma_1 \lambda) = \widetilde{b}$. Thus, the optimal y_1 such that $y_1 < b + 1/2$ is

$$y_1^A I_{\left(b > \widetilde{b}\right)} + \lim_{\varepsilon \to 0, \varepsilon > 0} (b + 1/2 - \varepsilon) I_{\left(b \leq \widetilde{b}\right)}. \tag{32}$$

In case B, the first order condition yields $y_1^B = 1 + b/(1+\lambda)$. Notice that $y_1^B \geq b + 1/2$ if and only if $b \leq (1+\lambda)/(2\lambda) = \widehat{b}$. Thus, the optimal y_1 such that $y_1 \geq b + 1/2$ is

$$y_1^B I_{\left(b \leq \widehat{b}\right)} + b + 1/2 I_{\left(b > \widehat{b}\right)}. \tag{33}$$

Observe now that $\widehat{b} < \widetilde{b}$. This implies that, if $b \leq \widehat{b}$, then y_1^B is optimal. If $\widehat{b} < b \leq \widetilde{b}$, then the kink point $b + 1/2$ is optimal. And if $b > \widetilde{b}$, then y_1^A is optimal.

Finally, notice that $y_0 \leq y_1^A \leq y_1^B$. Hence, IC_0' holds, and the claimed optimality of actions is shown. Optimal wages are now computed by inserting actions into w_1 and Δw. $\square$

Proof of Proposition 3: Let $\Delta w = w_0 - w_1$. P's objective can then be written as

$$V = \sum_{t,s\in\{0,1\}} \gamma_t \sigma_{st} \left[\alpha_s \left(-\lambda \left(y_s - t\right)^2\right) + \left(1-\alpha_s\right)\left(-\lambda b^2\right)\right] - \left(\gamma_0\sigma_{00} + \gamma_1\sigma_{01}\right)\Delta w - w_1. \tag{34}$$

The IC constraints can be written as

$$\text{IC}_0: \quad \Delta w \geq \alpha_0 \left(y_0 - b\right)^2 - \alpha_1 \left(y_1 - b\right)^2 \tag{35}$$

$$\text{IC}_1: \quad \Delta w \leq \alpha_0 \left(y_0 - b\right)^2 - \alpha_1 \left(y_1 - b\right)^2 + 2\left(\alpha_1 y_1 - \alpha_0 y_0\right) + \left(\alpha_1 - \alpha_0\right)\left(2b - 1\right) \tag{36}$$

Hence, IC_1 can be replaced by

$$\text{IC}_1': \qquad 0 \leq 2\left(\alpha_1 y_1 - \alpha_0 y_0\right) + \left(\alpha_1 - \alpha_0\right)\left(2b - 1\right) \tag{37}$$

This implies that w_1 can be reduced without violating the IC constraints. Thus, as w_1 enters V negatively, IR_1 must be binding. Hence, $w_1 = \alpha_1 \left(y_1 - (1+b)\right)^2$.

Moreover, IR_0 is implied by IR_1 and IC_0, because with $w_0 = w_1 + \Delta w$

$$\begin{aligned} w_0 &\geq \alpha_1 \left(y_1 - (1+b)\right)^2 + \alpha_0 \left(y_0 - b\right)^2 - \alpha_1 \left(y_1 - b\right)^2 && (38)\\ &= \alpha_0 \left(y_0 - b\right)^2 + \alpha_1 \left(2b + 1 - 2y_1\right) && (39)\\ &\geq \alpha_0 \left(y_0 - b\right)^2, && (40)\end{aligned}$$

where the last inequality holds since $b \geq 1/2$ by assumption and $y_1 \leq 1$ by OPT.

Hence, P's problem reduces to maximize V s.t. IC_0, IC_1', IND, BayR, OPT.

Notice that, as opposed to the case with perfect commitment, it is not obvious that it is optimal to Δw as small as possible. This is because Δw can no longer be chosen independently from σ and thus y. It is thus not necessarily optimal that IC_0 is binding. To see which IC constraint is binding in the optimum, we go through all cases and then compare the utilities.

Note however that it cannot be optimal that no IC constraint is binding, as in this case Δw can be reduced without changing the truthtelling probabilites (which equal 1 in this case) and the resulting actions. This leaves us with three cases: exactly one, or both IC constraints are binding. We consider them turn.

Suppose, first, that IC_0 is binding, and IC_1' holds with strict inequality. Then, by IND, $\sigma_{11} = 1$, and hence, by BayR and OPT, $y_0 = 0$. With this, P's objective becomes

$$\begin{aligned} V^{IC_0} = &-\gamma_0\sigma_{00}\lambda\left[\alpha_0 \cdot 0 + \left(1-\alpha_0\right)b^2\right] - \gamma_0\sigma_{10}\lambda\left[\alpha_1 y_1^2 + \left(1-\alpha_1\right)b^2\right] && (41)\\ &- \gamma_1\lambda\left[\alpha_1\left(y_1 - 1\right)^2 + \left(1-\alpha_1\right)b^2\right] - \left(\gamma_0\sigma_{00} + \gamma_1 \cdot 0\right)\Delta w - w_1. && (42)\end{aligned}$$

Since IR_1 and IC_0 are binding, $w_1 = \alpha_1 (y_1 - (1+b))^2$, and $\Delta w = \alpha_0 b^2 - \alpha_1 (y_1 - (1+b))^2$. Moreover, with $\sigma_{11} = 1$, BayR and OPT imply $\sigma_{10} = \gamma_1 (1 - y_1) / \gamma_0 y_1$.

With this, P's problem is to choose α_0, α_1, and $y_1 \in [\gamma_1, 1]$ so as to maximize V^{IC_0} evaluated at $w_1, \Delta w, \sigma_{10}$ subject to IC_1'. Straightforward algebra yields

$$V^{IC_0} = \alpha_0 (\lambda - 1) b^2 \left(1 - \frac{\gamma_1}{y_1}\right) - \alpha_1 (\lambda - 1) b^2 \left(1 - \frac{\gamma_1}{y_1}\right) \tag{43}$$

$$+ y_1 \alpha_1 [(\lambda - 1) \gamma_1 + 2] + \alpha_1 \left(-\gamma_1 \lambda + \lambda b^2 + 2\gamma_1 b - 1 - 2b\right) - \lambda b^2. \tag{44}$$

Since the first term is positive, α_0 is optimally set to 1. Notice that with $\alpha_0 = 1$ and $y_0 = 0$, IC_1' becomes redundant. It can now be easily seen that V^{IC_0} is monotonically increasing in y_1. Thus, $y_1 = 1$ in the optimum, and

$$V^{IC_0} = \alpha_1 \left[\gamma_1 \lambda b^2 - \gamma_1 b^2 + \gamma_0 (2b - 1)\right] - \gamma_0 (\lambda - 1) b^2. \tag{45}$$

Hence, α_1 is optimally set to 1 if and only if

$$\lambda \geq 1 + \frac{\gamma_0}{\gamma_1} \frac{2b - 1}{b^2} = \widehat{\lambda}. \tag{46}$$

In this case, $V^{IC_0}(1,1) = -b^2 - \gamma_0 (2b - 1)$. In the other case, $V^{IC_0}(1,0) = -\gamma_0 \lambda b^2 - \gamma_1 b^2$.

Second, suppose that IC_1' is binding, and IC_0 holds with strict inequality. Then, by IND, $\sigma_{00} = 1$, and hence, by BayR and OPT, $y_1 = 1$. With this, P's objective becomes

$$V^{IC_1} = -\gamma_0 \lambda \left[\alpha_0 y_0^2 + (1 - \alpha_0) b^2\right] - \gamma_1 \sigma_{01} \lambda \left[\alpha_1 (y_0 - 1)^2 + (1 - \alpha_1) b^2\right] \tag{47}$$

$$- \gamma_1 \lambda \left[\alpha_1 \cdot 0 + (1 - \alpha_1) b^2\right] - \gamma_0 \sigma_{00} w_0 - \gamma_0 \sigma_{10} w_1 - \gamma_1 w_1. \tag{48}$$

With the same steps as in the previous paragraph, V^{IC_1} can be written as

$$V^{IC_1} = \alpha_1 b^2 (\lambda - 1) \frac{\gamma_1 - y_0}{1 - y_0} - \alpha_0 \left[2b + 1 + (\lambda - 1)\left(y_0 - \frac{1}{1 - y_0} b^2\right)\right] - \lambda b^2. \tag{49}$$

Notice that IC_1' implies that $\alpha = (0,1)$ and $\alpha = (0,0)$ is not feasible. Further, it is easy to see that for the other cases V^{IC_1} is increasing in y_0. Thus, $y_0 = 0$ in the optimum. So $V^{IC_1}(1,0) = -\gamma_0 \lambda b^2 - \gamma_1 b^2$, and $V^{IC_1}(1,1) = -b^2 - \gamma_0 (2b + 1)$. Inspection shows that this is (weakly) dominated by V^{IC_0}, and cannot be optimal.

Suppose finally, that both incentive constraints are binding. IC_1' writes

$$- (1/2 + b - y_1) \alpha_1 + (1/2 + b + y_0) \alpha_0 = 0. \tag{50}$$

Since $b > 1/2$ and $y_1 \leq 1$, this equality can only hold for $\alpha_0 = \alpha_1 = 0$, or $\alpha_0 = \alpha_1 = 1$. Indeed, for $\alpha_0 = 0, \alpha_1 = 1$ the LHS of (50) is equal to $-(1/2 + b - y_1) < 0$, and for $\alpha_0 = 1, \alpha_1 = 0$ the LHS of (50) is equal to $(1/2 + b - y_0) > 0$. Now, for $\alpha_0 = \alpha_1 = 0$, we have unconditional delegation which, as seen above, is dominated by $V^{IC_0}(1,0)$, and thus cannot be optimal. For $\alpha_0 = \alpha_1 = 1$, (50) implies that $y_0 = y_1$. By OPT, it follows that $\mu_{10} = \mu_{11}$. Thus, by BayR,

$$\frac{\sigma_{01}\gamma_1}{\sigma_{01}\gamma_1 + \sigma_{00}\gamma_0} = \frac{\sigma_{11}\gamma_1}{\sigma_{11}\gamma_1 + \sigma_{10}\gamma_0}. \tag{51}$$

This is equivalent to $\sigma_{00} = 1 - \sigma_{11} = \sigma_{01}$. Hence,

$$y_0 = \mu_{10} = \frac{\sigma_{01}\gamma_1}{\sigma_{01}\gamma_1 + \sigma_{00}\gamma_0} = \gamma_1. \tag{52}$$

Moreover, since $y_0 = y_1$, $\Delta w = 0$. With IR_1 binding, $w_1 = w_0 = (\gamma_1 - (1+b))^2$. Thus,

$$V^{IC_0,IC_1}(1,1) = -\gamma_0\sigma_{00}\lambda\gamma_1^2 - \gamma_0\sigma_{10}\lambda\gamma_1^2 - \gamma_1\sigma_{01}\lambda(\gamma_1 - 1)^2 \tag{53}$$

$$- \gamma_1\sigma_{11}\lambda(\gamma_1 - 1)^2 - (\gamma_1 - (1+b))^2 \tag{54}$$

$$= -\gamma_0\gamma_1\lambda - \gamma_0^2 - 2b\gamma_0 - b^2. \tag{55}$$

Now notice that this is dominated by $V^{IC_0}(1,1)$, and thus cannot be optimal.

In sum, we have shown that in the optimum IR_1 and IC_0 are binding, and that IC_1 holds with strict inequality. In this case, $\alpha = (1,1)$ if and only if $\lambda \geq \widehat{\lambda}$, and $\alpha = (1,0)$ otherwise. □

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