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Failure to Delegate and Loss of Control

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Abstract

This paper provides an explanation for the frequently observed phenomenon of "inefficient micromanagement". I show that a supervisor may get comprehensively involved into activities of a subordinate although a better option of delegation is available. This inefficiency persists in the absence of conflict of preferences and even as the cost of delegation becomes zero. The paper also demonstrates that imposing constraints on communication with a subordinate can be beneficial for a superior.

1. Introduction

> Why is it that managers are typically running out of time while their subordinates are typically running out of work?
>
> "Management Time," Harvard Business Review, November-December 1999, p.179

President Carter's policy to personally review all requests for the White House tennis court is, perhaps, one of the most notorious examples of inefficient micromanagement.[1] Yet, excessive involvement of supervisors in routine activities of their subordinates is widespread in many areas of life. The business press is full of stories in which CEOs participate in decisions at the lowest hierarchical levels.[2] Management

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[1]Reported by James Fallows, chief White House speechwriter for President Carter's first two years in office, in The Atlantic Monthly; May 1979; Vol. 243, No. 5; pp. 33-48.

[2]See for example the articles "The Controversial Boss of Beatrice," Fortune, July 22, 1985, and "Pressured by KKR, Primedia CEO resigns," Wall Street Journal, April 18, 2003.

textbooks and surveys consistently list failure to delegate among the main characteristics of inefficient leadership.[3] Williamson [9], p.148, warns that the tendency of top-level management to engage "in the operating affairs of the divisions in an extensive and continuing way" compromises the optimal allocation of attention between short-run issues and long-run goals.

Why do managers fail to delegate and get buried in routine? Currently, the literature offers two explanations. The one argument is that "a desire to be comprehensively involved is evidently difficult to resist" (Williamson [9], p.149) and that "managers need to overcome the psychological desire to be indispensable" (Ghoshal and Bruch, [4], p.42). The other frequently suggested reason is that a subordinate cannot be trusted to take the optimal decision: "if I allow [the subordinate] to do this, how can I be sure that he will do it correctly?" (Walker [8], p.98).

Both of these explanations are problematic. First, do managers actually have an intrinsic preference for excessive micromanagement or is it an outcome of the interaction between a superior and a subordinate? Second, if a subordinate cannot be trusted but is, nevertheless, retained by his superior, then it is not surprising that the latter will (optimally) make her instructions more detailed.

In this paper, I show that inefficient micromanagement can arise endogenously as a consequence of a coordination failure between a supervisor and a subordinate; this result does not require the supervisor to have any intrinsic preference for micromanagement or the subordinate to be untrustworthy. In my model, the subordinate may come to rely on the expertise of the supervisor (an inefficient equilibrium), even if a better option of determining the optimal decision independently (an efficient equilibrium) is available. In the *inefficient* equilibrium, the supervisor fears that, unless she directs the subordinate, the latter will take an incorrect decision. Therefore, the supervisor has an incentive to babysit the subordinate by making decisions for him. As a result, the subordinate has no incentive to put any effort into independently coming up with the optimal decision, justifying the concern that he cannot be delegated decision-making.[4]

The seemingly straightforward solution for the problem of inefficient micromanagement is (1) to hire another, more experienced and better skilled, subordinate and/or (2) to better align interests of the subordinate and the supervisor. Perhaps surprisingly, this may not help. The inefficient equilibrium will exist even if the parties do *not* have any conflict of preferences and the cost of coming up with the optimal decision for the subordinate is *zero*. This paper characterizes necessary and sufficient conditions for the existence of this inefficiency.

The richer is the communication structure between the parties, the more likely

[3] See the survey on key business issues by the American Management Association, 1999, and the survey study "Competing in a Global Economy" by the Watson Wyatt, 1994, both of which list failure to delegate among top four "reasons for executive's failure" and "barriers to leadership development" correspondingly; for an early study on reasons for poor management see David Brown, [1], where failure to delegate and over-involvement were ranked first.

[4] In contrast, in the efficient equilibrium there is no active role for the supervisor. In reality, however, the supervisor is needed because not all decision problems can be addressed by the employee.

is the inefficient equilibrium to appear. Paradoxically, it can be advantageous for a supervisor to have constraints on the ability to communicate to subordinates. These constraints prevent the parties from completely resolving uncertainty through communication. Therefore, when the costs of determining the optimal decision by the subordinate are low (and hence delegation is efficient), he will have an incentive to analyze information and come up with a decision independently; in turn, it will remove the incentive for the supervisor to intervene in the affairs of the subordinate.

The inefficiency in my model is somewhat similar to what is called "Samaritan's dilemma" in parent - child relationships, where the child may come to suboptimally rely on the help of the parent.[5] However, whereas the conflict of interest between parties is an essential ingredient of the Samaritan's Dilemma, failure to delegate occurs (even) in the absence of such a conflict.

As in the Samaritan's Dilemma, if the supervisor (the parent) can commit to a specific behavior, the inefficiency disappears. One might also expect that over time the parties should be able to negotiate and agree to play the efficient equilibrium. Unfortunately, in reality commitment abilities of a supervisor are often limited, while renegotiation is costly and takes a long time. Moreover, the parties often have at least some conflict of interests. Although in that case the qualitative structure of equilibria would be the same, the difference in preferences would make it very difficult to coordinate on the ("efficient") equilibrium preferred by the supervisor.

The remainder of the paper is organized as follows: Section 2 presents an example. Section 3 describes the model. Section 4 presents the main result. Section 5 discusses how the inefficient equilibrium can be destroyed by constraining the supervisor's ability to communicate. Section 6 concludes.

2. Example

This section presents an example to illustrate the reasons for inefficient micromanagement. I will consider a simplified version of the model, where the only costs incurred by the supervisor stem from communication with the subordinate. (In the general model, the supervisor also has a cost of coming up with the optimal decision.) It is also assumed there are no technological constraints on communication. The result that communication constraints can be beneficial for both parties is postponed until the formal analysis.

There is a supervisor (she) and a subordinate (he). The subordinate's job is to implement product modifications. There are two equally likely states of the world. In the one state ($\omega = yes$) the innovation should be introduced, while in the other ($\omega = no$) it should not. In the first period, the supervisor observes the state and decides whether to meet with the subordinate, i.e., whether to send him a message, (M) or not (NM). The cost of the meeting is $c_m > 0$.[6] The subordinate, in the

[5] I thank James Andreoni for pointing out this connection. See Buchanan [3] and Bruce and Waldman [2] for more details.

[6] The results in this paper can be easily extended to the case of message-dependent communication

second period, observes whether the meeting has occurred and decides whether to pay a cost of $c_l \geq 0$ and learn (L) the state. After that, the subordinate chooses whether to introduce an innovation ($q = yes$) or not ($q = no$). The payoffs of the supervisor and the subordinate are the same. If the subordinate makes a decision that matches the state of the world then the payoffs are equal to one minus potentially incurred costs of communication and learning. Otherwise, the payoffs are zero minus the costs. I will use the Perfect Bayesian equilibrium solution concept. The extensive form of this game is presented in Figure 1.

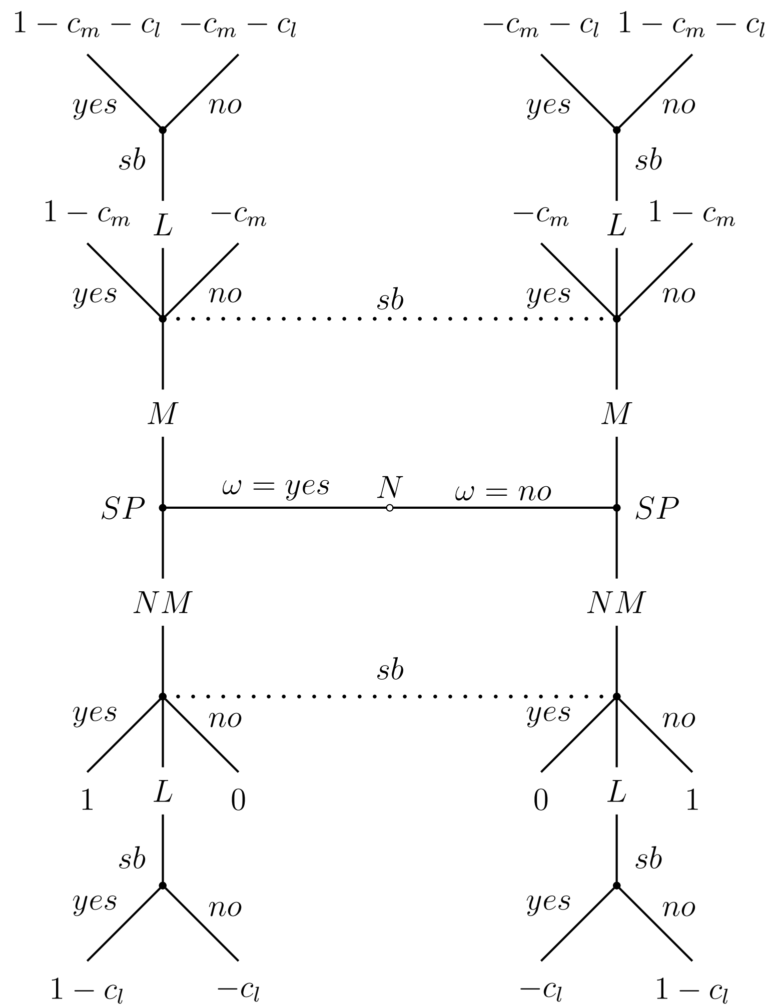

Figure 1. Example. Notation: N stands for Nature, SP for the supervisor, sb for the subordinate, $\omega = no$ for no innovation, $\omega = yes$ for innovation, M for communicating (meeting), NM for not communicating, L for learning the state, *yes* for introducing innovation, and *no* for not introducing the innovation; c_m is the cost meeting, c_l is the cost of learning the state, 1 is the profit if the action matches the state, 0 is the profit otherwise.

For $c_m > 0$ and $c_l \leq 1/2$, there is an equilibrium in which the supervisor never

costs, i.e., situations in which the cost of the meeting is determined by the content and duration of the meeting.

sends any message and the subordinate always pays c_l, learns the state of the world, and takes the correct action; in this equilibrium the payoff is $1 - c_l$. Because there are no meetings on the equilibrium path, the subordinate holds the prior beliefs that both states are equally likely. Hence, his behavior is optimal because the expected payoff from learning and taking the correct action, $1 - c_l$, exceeds the payoff from making the uninformed decision, $1/2$. The optimality of the supervisor's behavior can be supported by multiple off-equilibrium beliefs. One possibility is that off the equilibrium path the subordinate has the prior beliefs. In this case, it is a best response for the subordinate to mix with equal probability between both actions. (These out-of-equilibrium beliefs and behavior support the equilibrium in which the supervisor sends no message for the largest set of cost parameters.) It follows that the behavior of the supervisor is optimal because the payoff from sending no message, $1 - c_l$, exceeds the payoff from sending a message, $1/2 - c_m$.

At the same time, for $0 \leq c_m \leq 1$ and $c_l \geq 0$ there exists another equilibrium in which the supervisor initiates a meeting in (only) one of the states. This allows the subordinate to infer the state and to choose the correct action without paying c_l. In order to see this, let the supervisor communicate whenever the innovation is needed.[7] Then, in the second period, the subordinate believes that $\omega = yes$ if he was contacted by the supervisor and $\omega = no$ otherwise. As a result, he chooses to introduce an innovation only after the meeting. Next, the supervisor's behavior is optimal: If $\omega = no$ she achieves the highest possible payoff by doing nothing. However, if the state is $\omega = yes$ the supervisor chooses to meet with the subordinate to prevent him from making the incorrect decision.

The payoff in this equilibrium is equal to $1 - c_m/2$ and does not depend on c_l.[8] It follows immediately that this equilibrium is inefficient for $c_l < c_m/2$. Notice that it exists even if the costs of learning for the subordinate are zero.

3. Model

There is a supervisor (she) and a subordinate (he). The common prior beliefs about the state of the world ω are represented by a probability measure $\mu(\cdot)$ which has support on $\Omega \subseteq \mathbb{R}$.

Timing, actions, and costs. In the first period, the supervisor decides whether to pay a cost $c_L \geq 0$ and learn ω (L) or not (NL). That is, the costs incurred in the first period from learning are

$$C_L(x) = \begin{cases} c_L, & x = L; \\ 0, & x = NL. \end{cases}$$

[7] Of course, there is also an equilibrium in which the supervisor communicates whenever the innovation is *not* needed.

[8] In this game, as long as $c_m \neq c_l$, these are the only two equilibria. Otherwise, there might exist equilibria in mixed strategies, in which the supervisor randomizes between communicating to the subordinate and not.

After that, the supervisor can pay a cost $c_M \geq 0$ and send a message $m \in M$ to the subordinate. I will denote sending no message as sending an empty message $m = \phi$. Therefore, the cost of sending a message can be represented as

$$C_m(m) = \begin{cases} c_M, & m \in M; \\ 0, & m = \phi. \end{cases}$$

In the second period, the subordinate observes the message (or no message) sent by the supervisor. After updating his beliefs about ω, the subordinate decides whether to pay a cost $c_l \geq 0$ and learn the state of the world (l) or not (nl). The costs incurred in the second period are

$$C_l(y) = \begin{cases} c_l, & y = l; \\ 0, & y = nl. \end{cases}$$

Finally, the subordinate chooses an action (a decision) $d \in \mathbb{D} \subseteq \mathbb{R}$.

Payoffs. The supervisor and the subordinate have *the same* payoffs that are represented by the difference of the utility from the taken action, a continuous function $v(d, \omega)$, and all incurred costs:

$$u = v(d, \omega) - C_m(m) - C_L(x) - C_l(y).$$

I assume that for every ω there is a unique action that maximizes $v(\cdot, \omega)$ and that it is different and unique for every ω:

$$\arg\max_d v(d, \omega) = \{d_\omega\},$$

and for any $\omega^{'}$ and $\omega^{''}$, $\omega^{'} \neq \omega^{''}$,

$$d_{\omega^{'}} \neq d_{\omega^{''}}.$$

It is also assumed that the action that maximizes the expected payoff given prior beliefs is unique

$$\arg\max_d \int_\Omega v(d, \omega) d\mu = \{\overline{d}\}.$$

Remark. In this setting, a message sent by the supervisor can be viewed as a recommendation of an action. Therefore, $card(M)$ may be interpreted as the cardinality of the set of actions that can be induced by communication. The assumption that the action that maximizes $v(d, \omega)$ is unique and different for every ω implies that the cardinality of the set of possibly optimal decisions equals to $card(\Omega)$. If $card(M) < card(\Omega)$, the set of actions that can result from communication alone is strictly contained in the set of potentially optimal actions. At this point, I do not impose any restrictions on the cardinality of M: I will study communication structures that are capable of resolving all uncertainty, e.g., $M = \Omega$, as well as that are not capable of it, i.e., M for which $card(M) < card(\Omega)$.

Solution concept. The appropriate solution concept for this game is the Perfect Bayesian equilibrium (certain care should be taken in defining Bayesian beliefs since for some $\mu(\cdot)$ all states can occur with probability zero).

Fully informative equilibria. There may be multiple equilibria that differ in the amount of transferred information. The equilibria in which the supervisor learns the state and sends messages to the subordinate in the manner that allows the latter to infer the state are particularly interesting for our purposes. I call such equilibria fully informative.

Efficiency. The efficient equilibrium is the equilibrium that yields the parties the highest ex-ante expected payoff among all equilibria, $U^{\bullet}(c_L, c_m, c_l)$. Similarly, the most inefficient equilibrium is an equilibrium with the lowest ex-ante payoff, $U_{\bullet}(c_L, c_m, c_l)$.

4. Inefficient Allocation of Decision Making

In this section, I study the case in which $M = \Omega$, i.e, the message space is rich enough to always convey the value of the realized state to the subordinate and thus communication is capable of inducing the optimal action in every state. One might expect that as the cost of learning by the subordinate goes to zero, so should the losses even in the most inefficient equilibrium. Unfortunately, this is not necessarily true: the inefficiency losses might not disappear even if the subordinate can learn the state at no cost. Below, I characterize the necessary and sufficient conditions on the preferences and the information structure such that the payoff in the most inefficient equilibrium does not improve as the cost of learning for the subordinate c_l converges to zero.

In my model, there can be an equilibrium, in which the supervisor never learns the state of the world and never sends any messages, while the subordinate pays c_l, learns the state of the world ω, and chooses the optimal decision d_ω. It is easy to demonstrate that for any fixed $c_m > 0$, $c_L > 0$, and small costs c_l this equilibrium exists: Because there is no communication and c_l is small, it is optimal for the subordinate to learn the state and make an informed decision. On the other hand, the supervisor knows that the subordinate is going to learn the state of the world and therefore she has no incentive to pay an extra cost of learning the state and sending a message.

This equilibrium is efficient for small enough c_l. In any other equilibrium (if it exists) the supervisor learns the information and/or sends messages at least for some ω. After each such message the subordinate does not pay c_l and does not learn the state of the world (otherwise, sending a message cannot be optimal). Thus, there is a tradeoff between the cost of learning and sending the messages by the supervisor and the cost of learning by the subordinate. If c_l is small, learning information by the subordinate and doing nothing by the supervisor is efficient. Hence,

Lemma 1 *For any $c_m > 0$ and $c_L > 0$ there exists c' such that for all $c_l \leq c'$ there is an efficient equilibrium in which the supervisor does not learn the state and does* *not send any messages, while the subordinate learns the state and takes the optimal action.*

Proof Denote a pure strategy of the supervisor by a triple (x, m_{NL}, m_L), where $x \in \{L, NL\}$ is the decision whether to learn the state of the world, $m_{NL} \in M$ is the message in the absence of learning, and $m_L : \Omega \to M$ is the message sent after learning the state of the world.

Next, denote the strategy of the subordinate by a triple (y, d_m, d_l), where (1) $y : M \to \{l, nl\}$ is the decision about whether to learn the state (which depends on the received message), (2) $d_m : M \to \mathbb{D}$ is the action taken when the subordinate does not learn the state and updates his beliefs based solely on the received message, and (3) $d_l : \Omega \to \mathbb{D}$ is the action taken after the subordinate learns the state (strictly speaking, d_l should be defined on $M \times \Omega$ but because ω is known at the point of the decision, d is independent of m sent).

In addition, let $\mu_m(\cdot)$ be the beliefs of the subordinate about the state after observing message m. I will not talk explicitly about beliefs at all other nodes in the game, because these are always either the prior beliefs (before learning the state) or beliefs that have a mass point on the true state of the world (after learning the state).

Consider the triple of the supervisor's strategy (NL, ϕ, ϕ), the subordinate's strategy $(l, \overline{d}, d_\omega)$, and the subordinate's beliefs $\mu_m(\cdot) = \mu(\cdot)$. If c_l is small enough, this is an equilibrium.

The beliefs are Bayesian. On the equilibrium path, the supervisor always sends the same message ϕ (no communication) and therefore there is no new information for the subordinate. Off the equilibrium path, beliefs can be arbitrary.

The strategy of the supervisor is the best response. Given that the subordinate will hold the prior beliefs even after communicating with the supervisor, messages do not have any effect. The supervisor then optimally chooses the least costly alternative to send no message, ϕ.

The strategy of the subordinate is the best response for small enough c_l. By definition of d_ω and $\overline{d}$ they are optimal actions given correspondingly the knowledge of the state and the prior beliefs. It follows that learning the state gives a payoff of $\int_\Omega v(d_\omega, \omega) d\mu - c_l + C$, while not learning $\int_\Omega v(\overline{d}, \omega) d\mu + C$ for some constant C representing the remainder of the payoff. Learning is optimal when $c_l \leq c_1 = \int_\Omega v(d_\omega, \omega) - v(\overline{d}, \omega) d\mu$, where $c_1 > 0$ by the assumption that d_ω is different for each ω.

This equilibrium is efficient for small enough c_l. To see this, imagine that some other equilibrium exists. Then, it must be that on the equilibrium path the supervisor with strictly positive probability $p > 0$ sends some messages different from ϕ. Furthermore, these messages must affect the final decisions taken, otherwise the supervisor would have not incurred the cost of sending the message. In order to have any effect, these messages must be sent after the supervisor learns the state of the world. For any such message m', let $d_{m'}$ be the taken action. The realized payoff after m' is $u(m') = v(d_{m'}, \omega) - c_L - c_m - C_l(y) \leq v(d_\omega, \omega) - c_L - c_m$. Correspondingly, if the message is not sent, the payoff can be bounded by $v(d_\omega, \omega) - c_L$. It follows that the total payoff in this equilibrium must be weakly less than $v(d_\omega, \omega) - c_L - pc_m$. Comparing it with the payoff in the original equilibrium, $v(d_\omega, \omega) - c_l$, we obtain that the latter is higher if $c_l \leq pc_m + c_L$.

To finish the proof set $c^{'} = \min\{c_1, c_L\}$.

□

Let us now turn to inefficient equilibria. Assume that the supervisor learns the state of the world and sends the messages in a manner that allows the subordinate to always infer the realized state. In this case, for any cost $c_l \geq 0$, the subordinate cannot gain anything from learning the state. Therefore, it is a best response for him to never learn the state and take the optimal action given the beliefs about ω updated using the message. Whether this behavior of the subordinate makes it optimal for the supervisor to communicate in the way that resolves all uncertainty for the subordinate depends on the structure of preferences.

One way for communication to be fully informative is for the supervisor to send no message in one state, say ω_1, and to send a different message for each of the remaining states in $\Omega \backslash \omega_1$.[9] It is only necessary to guarantee that after a realization in $\Omega \backslash \omega_1$ the supervisor does not want to deviate to sending no message or sending a different message. (There is no profitable deviation after ω_1 since the subordinate takes d_{ω_1} and no communication cost is paid.) In this case, (ignoring the sunk costs) the conditional payoff from sending a message is $v(d_\omega, \omega) - c_m$ and the conditional payoff from sending no message is $v(d_{\omega_1}, \omega)$. There is no profitable deviation if and only if $v(d_\omega, \omega) - v(d_{\omega_1}, \omega) \geq c_m$ for all $\omega \in \Omega \backslash \omega_1$. (The rest of possible deviations are to send some other - possibly not used - messages. They are easy to deal with by assigning a belief $\omega = \omega_1$ to all out-of-equilibrium messages.) Formally, for every $\omega \in \Omega$ define $c(\omega) = \inf\limits_{\omega^{'} \in \Omega \backslash \omega} \left(v(d_{\omega^{'}}, \omega^{'}) - v(d_\omega, \omega^{'})\right)$. It follows that there is an equilibrium with fully informative communication if and only if $\mathcal{C} = \sup\limits_{\omega \in \Omega} c(\omega)$ is strictly greater than zero.

Remark. Clearly, as the example in Section 2 shows, there are situations in which $\mathcal{C} > 0$. However, if the range of $v(\Omega) = \{v \in \mathbb{R} | v = v(d_\omega, \omega), \omega \in \Omega\}$ is an interval, $\mathcal{C} = 0$.[10]

Lemma 2 *There exists $c_m^{'}$ and $c_L^{'}$ such that for any $0 < c_m \leq c_m^{'}$, $c_L \leq c_L^{'}$, and any $c_l \geq 0$, there exists an equilibrium with fully informative communication if and only if $\mathcal{C} > 0$. The payoff in this equilibrium is independent of c_l.*

Proof *Sufficiency.* Assume $\mathcal{C} > 0$. Then, it is possible to find $\omega_0 \in \Omega$ such that

$$c(\omega_0) = \inf_{\omega \in \Omega \backslash \omega_0} \left(v(d_\omega, \omega) - v(d_{\omega_0}, \omega)\right) > 0.$$

[9]There is another possibility in which the supervisor sends messages in all states of the world. However, if this behavior is a part of equilibrium then this equilibrium must be efficient.

[10]Even in this case, the equilibrium with fully informative communication may be possible if the cost of communication, c_m, is message-dependent.

Let the supervisor's strategy be (L, ϕ, m_L), where $m_L(\omega_0) = \phi$ and for any two different ω_1 and ω_2, $m_L(\omega_1) \neq m_L(\omega_2)$. (It is always possible to find such m_l if $card(M) = card(\Omega)$.) This strategy allows to define the inverse function $m_L^{-1} : M \to \Omega$ to $m_L(\cdot)$. Next, let the subordinate's strategy be $(nl, d_{m_L^{-1}(m)}, d_\omega)$, where $m_L^{-1}(m)$ is extended to $m_L^{-1}(m) = \omega_0$ for m off the equilibrium path. Finally, let the subordinate's beliefs put probability one to $m_L^{-1}(m)$ on the equilibrium path and probability one to $\omega^{'}$ for the messages out of the equilibrium path.

These strategies and beliefs are an equilibrium if $c_m \leq c(\omega_0)$. Clearly, the beliefs of the subordinate are Bayesian on the equilibrium path and his strategy is a best response given his beliefs. Thus, we only need to show the optimality of the supervisor's behavior.

After realization ω_0, the supervisor sends no message ϕ, the subordinate correctly infers the state of the world, and the continuation payoff is $v(d_{\omega_0}, \omega_0) - c_L - c_m$, which cannot be improved upon by any deviation.

After any other realization ω, the supervisor obtains the continuation payoff of $v(d_\omega, \omega) - c_L - c_m$ and has three types of deviations. He can choose to send a different message $m^{'} \neq m_L(\omega)$ that is observed on the equilibrium path. This will give the payoff $v(d_{m_L^{-1}(m')}, \omega) - c_L - c_m$, which is strictly worse. Second, he can deviate to sending a message that does not occur on the equilibrium path. The subordinate will believe that the state is ω_0, which will also give a strictly lower payoff of $v(d_{\omega_0}, \omega) - c_L - c_m$. Finally, the supervisor can deviate to sending no message, ϕ. This will give the payoff of $v(d_{\omega_0}, \omega) - c_L$, which is strictly lower then the equilibrium payoff because $c_m \leq c(\omega_0) \leq v(d_\omega, \omega) - v(d_{\omega_0}, \omega)$.

Last, we need to demonstrate that it is optimal for the supervisor to learn the state of the world. The equilibrium payoff is $\int_\Omega v(d_\omega, \omega) d\mu - c_L - (1 - \mu(\omega_0))c_m$. If the supervisor does not learn the state of the world, then the best he can do is to send either no message (leading to the decision of d_{ω_0}) or the message (that occurs on the equilibrium path and leads to, say, decision $d_{\omega'}$) that will maximize the payoff given the prior beliefs. Thus, the payoff from the best deviation is $\overline{u} = \max\{\int_\Omega v(d_{\omega_0}, \omega) d\mu, \int_\Omega v(d_{\omega'}, \omega) d\mu\} - c_m\}$. The deviation is not profitable if $c_L \leq \overline{c}_L = \int_\Omega v(d_\omega, \omega) d\mu - (1 - \mu(\omega_0))c_m - \overline{u}$. Finally, to guarantee that $\overline{c}_L > 0$ it is enough to notice that

$$c_m \leq \overline{c}_m = \frac{\int_\Omega \left(v(d_\omega, \omega) - v(d_{\omega_0}, \omega)\right) d\mu}{1 - \mu(\omega_0)}$$

This condition is satisfied since

$$c_m \leq c(\omega_0) \leq v(d_\omega, \omega) - v(d_{\omega_0}, \omega) \leq \frac{v(d_\omega, \omega) - v(d_{\omega_0}, \omega)}{1 - \mu(\omega_0)} = \overline{c}_m$$

Necessity. Assume that $\mathcal{C} = 0$. I am going to show that there is no fully informative equilibrium. Potentially, there can exist only two types of fully informative equilibrium. In both of them, the supervisor always learns the state of the world.

In the equilibrium of the first type, the supervisor sends a distinct message in every state of the world, with the exception with some state ω_0, in which he sends no message ϕ. This empty message ϕ leads to a action d_{ω_0}. If $\mathcal{C} = 0$, then regardless of the exact values of ω_0 and c_m it is possible to find ω such that $v(d_\omega, \omega) - c_m < v(d_{\omega_0}, \omega)$. But then the supervisor would deviate to sending no message when the state is ω.

In the equilibrium of the second type, the supervisor sends a distinct non-empty message in every state of the world. There are two possibilities. First, in the case of observing the out-of-equilibrium message ϕ the subordinate may choose not to learn the state of the world and take some action d_ϕ, which is optimal given his out-of-equilibrium beliefs. In this case, in order for the supervisor not to deviate to sending ϕ, it should be that $v(d_\omega, \omega) - c_m \geq v(d_\phi, \omega)$ for all ω. But there should exist at least some $\omega^{'}$ for which $v(d_\phi, \omega^{'}) \geq v(d_{\omega_0}, \omega^{'})$; otherwise d_ϕ cannot be the best response to ϕ for any beliefs. Taken together, $v(d_{\omega^{'}}, \omega^{'}) - c_m \geq v(d_{\omega_0}, \omega^{'})$ contradicts $\mathcal{C} = 0$.

The second possibility is that after observing the out-of-equilibrium message ϕ the subordinate learns the state. Then there will exist $\tilde{c}_l c_m$ such that for all $c_l < \tilde{c}_l$ the payoff on the equilibrium path $v(d_\omega, \omega) - c_m$ will be strictly less than the payoff from deviation to ϕ, $v(d_\omega, \omega) - c_l$, and thus the supervisor will find it optimal to deviate.

□

One may notice that if the cost of learning the state by the subordinate is small, the only equilibria that can exist are those established in Lemmas 1 and 2: it is either that there is no communication and the subordinate learns the state independently or that communication between the parties is fully informative and the subordinate never learns the state. The only other possibility is to have an equilibrium in which the supervisor learns the state but communication takes such form that the subordinate (at least sometimes) is not completely convinced about the value of the realized state of the world. But, then, for small enough c_l there are strictly positive gains from learning the state by the subordinate. In turn, if the subordinate is going to learn the state of the world, then the supervisor is better off sending no message to save on communication costs. Thus,

Lemma 3 *There is $c^{''}$ such that for any $c_l < c^{''}$ there exist at most two types of equilibria: with fully informative communication and without communication. Both equilibria exist simultaneously if and only if $c_\emptyset > 0$. Otherwise, the only existing equilibrium is without communication.*

Proof The strategy of the supervisor in the equilibrium with fully informative communication is (L, m_{NL}, m_L), where m_{NL} is arbitrary and $m_L(\cdot)$ is such that for any two different ω_1 and ω_2, $m_L(\omega_1) \neq m_L(\omega_2)$. In the equilibrium without communication the supervisor's strategy is (NL, ϕ, m_L) where m_L is arbitrary.

The only other candidates for the equilibrium are (1) (L, m_{NL}, m_L) where m_L does not always produce distinct messages for different states, (2) (NL, m_{NL}, m_L) where $m_{NL} \neq \phi$, and (3) a strategy in which the supervisor mixes between learning and not learning the state of the world.

In the first case, there should be a message m after which the subordinate's beliefs μ_m are imprecise and for any decision $d^{'}$, $\int_\Omega v(d_\omega, \omega)d\mu_m > \int_\Omega v(d^{'}, \omega)d\mu_m$. Therefore, for small c_l the subordinate will learn the state of the world. But if this is the equilibrium strategy, then the supervisor is better off sending no message ϕ, which implies that ϕ is the only message after which the beliefs are imprecise. Then, for every message on the equilibrium path (for small enough c_l) the supervisor will find it optimal to deviate to ϕ, which will trigger learning by the subordinate.

The strategy in the second case cannot be a part of an equilibrium because otherwise the supervisor would be better off deviating to always sending no message, ϕ.

The argument for the case of a mixed learning strategy is completely analogous to the first case.

□

Now I present the main result that the inefficiency loss need not disappear as the cost of learning information for the subordinate goes to zero. Lemma 1 says that for small costs of learning c_l, in the efficient equilibrium the supervisor does not learn the state of the world and does not communicate with the subordinate, while the subordinate learns the state of the world independently. The payoff in this equilibrium converges to the payoff which would be achieved in the world of perfect information as the cost c_l converges to zero because the only losses in this equilibrium are due to learning and paying c_l. On the other hand, Lemmas 2 and 3 imply that (if and only if $c_\emptyset > 0$) there are inefficient equilibria whose payoffs are independent of c_l. Therefore,

Proposition 1 *If and only if $\mathcal{C} > 0$, there exists $c^*(c_L, c_m) > 0$ such that for any $c_l < c^*$ the difference of the payoffs in the efficient and the most inefficient equilibria $U^\bullet(c_L, c_m, c_l) - U_\bullet(c_L, c_m, c_l)$ is strictly greater than zero (and is increasing as c_l becomes smaller). Otherwise, $U^\bullet(c_L, c_m, c_l) - U_\bullet(c_L, c_m, c_l) = 0$.*

Proof If $\mathcal{C} = 0$, Lemma 3 implies that for small c_l there is a unique equilibrium. If $\mathcal{C} > 0$, Lemma 3 implies that there are only two equilibria, a fully informative equilibrium and an equilibrium without communication. The payoff in the fully informative equilibrium is equal to $\int_\Omega v(d_\omega, \omega)d\mu - c_L - (1 - \mu(\omega_0))c_m$ where ω_0 is some state in Ω and is independent of c_l. The payoff in the equilibrium without communication is (for small c_l) equal to $\int_\Omega v(d_\omega, \omega)d\mu - c_l$. The direct comparison of the payoffs gives the result in the proposition.

□

5. Constrained Communication

In this section I assume that $\mathcal{C} > 0$ and analyze how imposing constraints on communication can destroy inefficient equilibrium. The result in Proposition 1 that even as the learning costs c_l become arbitrarily small the possible inefficiency losses do not vanish is obtained under the assumption that $M = \Omega$ and thus there exist (inefficient) equilibria in which the messages of the supervisor resolve all uncertainty for the subordinate. Here I show that if the dimensionality of the message space M is smaller than the dimensionality of the space Ω then the inefficiencies must disappear as c_l becomes small. The intuition for this result is straightforward. When the message space is not rich enough, the set of actions that can be induced by the communication is strictly contained in the set of potentially optimal actions. Then, for small enough c_l there are strictly positive gains from learning the state by the subordinate. We have the following

Proposition 2 *If $\mathcal{C} > 0$ then there exists c^{**} such that for any $c_l < c^{**}$ the equilibrium is unique if and only if $card(M) < card(\Omega)$. In this equilibrium there is no communication.*

Proof The results in Lemmas 1 and 3 are proven without relying on the assumption about cardinality of M and Ω. In contrast, Lemma 2 requires that $card(M) \geq card(\Omega)$. Thus, we only need to show that when this is not the case there cannot exist a fully informative equilibrium.

If $card(M) < card(\Omega)$, it is impossible to construct a function that assigns a distinct message to every state of the world. In this case, in any equilibrium there will be a message m after which the subordinate beliefs μ_m are imprecise and for any decision $d^{'}$, $\int_\Omega v(d_\omega, \omega) d\mu_m > \int_\Omega v(d^{'}, \omega) d\mu_m$. Therefore, for small c_l the subordinate will learn the state of the world. Hence, a fully informative equilibrium cannot exist.

□

A noisy communication device is another means of destroying the inefficient equilibrium. Assume that if the supervisor sends a message m then the subordinate receives the original message m with probability $1 - p$ and a different message $m^{'} \in M$ with probability p ($m^{'}$ can be random).

In this scenario, after observing the message the subordinate cannot be completely convinced about the state of the world. If p is sufficiently high or c_l is sufficiently low then the subordinate will always learn the state and the equilibrium in which it completely relies on the messages would not exist. Hence,

Proposition 3 *In the game where the messages are distorted with probability p and $\mathcal{C} > 0$ there exists $\tilde{c}$ such that for any $c_l < \tilde{c}$ the equilibrium is unique. In this equilibrium there is no communication.*

Proof is similar to the proof of Proposition 2 and therefore is skipped.

□

6. Conclusions

In this paper I study possible reasons for inefficiency in information processing in organizations and institutions. In particular, I am interested in explaining the apparently suboptimal decision practices where a supervisor micromanages the behavior of an employee. I show that even in the absence of conflict of preferences, the subordinate may rely on the information provided by the supervisor, although it would be more efficient to collect information independently. The fact that the supervisor is expected to come up with the optimal decisions crowds out the initiative of the subordinate. In turn, this creates incentives for the supervisor to collect and process information even if it is very costly.

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