Economic Theories of Middle Management: Monitoring, Communication, and the Middle Manager's Dilemma

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This article aims at summarizing several organizational functions of middle management, and clarifying their tradeoffs. Setting up and analyzing a simple model of a top, a middle, and a bottom manager, we show the following results: (i) middle management benefits the organization only if the middle manager has higher information gathering capabilities than the top, as well as serving to have effective monitoring and communication functions; and (ii) more communication from the middle to the top is not necessarily desirable for the organization, because of its detrimental effect on the bottom. Result (ii) arises from a tradeoff between communication and incentives: While more communication improves project implementation by the top, it discourages the bottom to take the initiatives to find and propose a new project. We then discuss how our results are related to important features of stylized Japanese management.

I. Introduction

Given that most firms are organized as multi-tier hierarchies, there is little doubt that middle managers like section chiefs and department heads should play important roles. If we define middle managers as those who are located between top management and rank-and-file employees and manage subgroups within the firm, 8% of all the employees working at firms with more than one hundred employees are classified as middle managers, as of 2001 (Sato 2004).

If middle managers are so important, however, the following quote of Yoshio Tateishi, chairman of Omron at the time, might sound paradoxical:

> To change middle managers' mind-set, we introduced a new system that encouraged them to take paid-leave of a maximum three months. Some managers worried. "How could the subordinates of my section do their jobs without me for three months!" However, once the managers took their leave, the performance of some sections actually improved. (*Nikkei Business*, January 19, 2004, p. 1)

The case like this raises the following questions. "What roles do middle managers play in the administration of the organization they belong to?" "How do their roles relate with firm performance?" The purpose of this paper is to summarize functions of middle managers and examine their relation with firm performance, from the perspective of organizational economics.

In particular, we emphasize a particular tradeoff among their roles and functions. One might postulate some monotonic relationships between the degree to which roles are accomplished and performance resulted from them, such that a firm's performance increases as its engineers serve their functions (e.g., developing products consumers want to purchase) harder. We in contrast argue that with respect to middle managers' functions, more is not necessarily better: it is important to understand there is a reason middle managers should play their roles "moderately." The case of Omron quoted above can be understood this way. Middle managers, who recognize the importance of their functions, may attempt to play their roles actively. However, that may lead to too much intervention to allow further contributions to organizational performance. At Omron, the introduction of the paid-leave system could have mitigated this problem and resulted in performance improvement.

The central problem to be analyzed in this paper is to clarify rigorously how this sort of non-monotonic relationship arises. In Section II we first summarize roles and functions of middle management based on existing literature in organizational economics. We then introduce the basic model in Section III, and explain two functions of middle managers (monitoring and communication) by extending the model. In Section V we explain the tradeoff we call the "middle managers' dilemma" and its logic, and then discuss its relevance to management of Japanese firms.

II. What Do Middle Managers Do

Analyzing the roles of middle management is almost equivalent to analyzing the advantages of a (at least) three-tier organizational structure of top, middle, and rank-and-file (bottom) members over a two-tier structure of top and bottom. For simplicity, in this paper we call the three-tier structure "hierarchy."

The existing literature on hierarchy in organizational economics can take either a "mechanical" approach or a "human" approach. The mechanical approach abstracts away managers' incentive problems so that managers are supposed to fulfill their specific functions such as information processing, monitoring, and so on, without any extra cost. The approach instead focuses on efficient assignments of managers, such as span of control (the number of managers per hierarchical level), and efficient organization design, such as a flat or tall structure. In contrast to this approach, the human approach pays explicit attention to misalignment of managers' interests from that of the organization as a whole, and takes into consideration the possibility that managers behave against the interest of the organization. This approach hence deals with incentive problems in organizations in addition to the organization design problem, the subject of the mechanical approach. Although the human approach demands more complicated analysis, many recent developments in organizational economics, such as comparative analyses of centralization versus decentralization, take this approach. We refer to Mookherjee (2006) for an overview.

The main functions of hierarchies can be classified into three: problem solving (use of knowledge), information processing, and monitoring. First, hierarchy can be understood as the following problem solving structure. The members at the bottom of the hierarchy specialize in solving routine production problems. If a problem is unusual, the members at the bottom send it to the middle managers for help, who are more knowledgeable and better able to deal with such problems. If a problem is truly exceptional, it continues up to the top of the hierarchy. Although increased communication must accompany this hierarchy, the organization can increase the utilization rate of the knowledge of the more knowledgeable experts by shielding them from problems that can be solved by less knowledgeable members. In this view of the hierarchy, middle managers contribute to the problem solving capabilities of the organization, by both solving unusual problems that cannot be solved by the members at the lower tiers, and transferring information about exceptional problems up to the top. Garicano (2000) is the first theoretical work in organizational economics focusing on the problem solving nature of hierarchy.

The second function is information processing. We explain this function using an example of a food producer. Under the two-tier organizational structure, each of the stores and factories sends information about sales and production directly to the top management, who must spend huge amounts of time for strategic planning and operational decisions. Under the hierarchy, information is processed and aggregated at the middle for each category before it is sent to the top. For example, sales managers and production managers can engage in parallel processing of sales and production data, respectively. In this view middle managers contribute by processing information and alleviating information overload at the top. Radner (1992) provides an accessible overview.

The third function is monitoring. Compared with the first two functions which exclusively follow the mechanical approach, this function is related to the human approach. As the organization grows larger, members are more likely to shirk their tasks. To deter shirking requires monitoring, and the number of subordinates one supervisor is able to monitor effectively is limited. As the number of subordinates increases, the number of supervisors increases, and those supervisors also must be monitored; otherwise, they would shirk their monitoring tasks. The hierarchy is then understood as a chain of monitoring. There is extensive existing literature in organization economics that studies the monitoring function. Qian (1994) is one of the most recent works along this line.

While these three functions mainly concern the process from the bottom to the top, the top-down process is equally important to understand the functions of the hierarchy. Leadership is one such function. Managers could be understood as leaders for their subordinates. Although economic analysis of leadership is still scarce, Hermalin (2008) provides an overview of the current research. In this paper, we mostly analyze roles of middle managers from the standpoint of the bottom-up process.

Although the third function of monitoring is based on an incentive problem of shirking, the other functions are considered under the limited, mechanical approach. In this paper

Table 1. Three Projects, Payoffs, and Probabilities

	Project 1	Project 2	Project 3
T	$\overline{v}$	$-\underline{v}$	$-\underline{v}$
M	$\overline{v}$	$\overline{v}$	$-\underline{v}$
B	$\overline{v}_B$	$\overline{v}_B$	$\overline{v}_B$
(Probabilities)	$\beta\gamma$	$\beta(1-\gamma)$	$1-\beta$

we emphasize the human approach, and in particular focus on the information transmission/communication function of middle managers. The top of the hierarchy obtains information through the middle managers in contrast to the two-tier structure where the top directly obtains information from the bottom. This difference is not significant if middle managers transmit their information "mechanically" to the top. However, if middle managers are "humans" having goals distinct from the goal of the organization as a whole, information transmission via middle managers may be more distorted or costly than communication in the two-tier structure. We analyze under what conditions hierarchy is desirable in terms of information transmission.

III. Information and Organizational Structures

1. The Model

In this and the following sections, we clarify roles of middle managers and the necessary conditions for their *raison d'être* rigorously by setting and analyzing a theoretical model along the human approach. We thus compare the two-tier structure with top (T) and bottom (B), and the three-tier structure (hierarchy) with top (T), middle (M), and bottom (B). If the latter structure is desirable in terms of T's objective, we can say middle managers are playing important roles.

The organization faces whether or not to implement a project (see Table 1). There are three possible projects, 1, 2, 3, only one of which is realized stochastically. Project i is realized with probability p_i ($p_1 + p_2 + p_3 = 1$). Each of T, M, B has a particular preference over the implementation of three projects. Project 1 yields $\overline{v} > 0$ to T and M, while it yields $\overline{v}_B > 0$ to B. Project 2's payoff to T is negative $-\underline{v} < 0$ while it is positive $\overline{v} > 0$ and $\overline{v}_B > 0$ to M and B, respectively. Finally, the payoff from project 3 is negative $-\underline{v} < 0$ to T and M, while it is positive $\overline{v}_B > 0$ to B. The bottom line is that although T wants to implement the project if and only if it is project 1, M wants to implement only projects 1 and 2, and B wants to implement all the projects. This conflict of interest could arise from their hierarchical positions and tasks. For example, while project 3 is profitable for B's business, it may not be profitable for M because the implementation of project 3 brings a large negative externality into another (unmodeled) business that is under M's control. Project 2 is not prof-

Table 2. Organizational Structures and Our Subjects

	# of ranks	Decision Maker	Our Subjects
(a)	2	T	Centralization
(b)	2	B	×
(c)	3	T	Hierarchy
(d)	3	M	×
(e)	3	B	×

itable for T because, for example, it has a negative impact on the organization's overall future strategic position, which is not a concern for M. We normalize their payoffs to zero if no project is implemented.

We further specify the realization probabilities by $p_1 = \beta\gamma > 0$, $p_2 = \beta(1 - \gamma) > 0$, and $p_3 = 1 - \beta > 0$, as in Table 1. In other words, the project is desirable for M with probability β, and given that it is desirable for M, the payoff of the project to the organization as a whole is positive with probability γ, which can be interpreted as the parameter of congruence between T and M.

Table 2 shows five feasible organizational structures in terms of the number of ranks and decision maker. In our model, structures (a) and (c) are at least as desirable for T as (b), (d), and (e). We hence focus on two structures: (a) the two-tier structure is adopted, B proposes a project, and T decides whether or not to ratify the project implementation; and (c) the three-tier structure is adopted, B proposes a project to M, M proposes a project to T, and T decides whether or not to ratify the project implementation. We call (a) centralization and (c) hierarchy.

2. Information Structures

We start our analysis under the assumptions of symmetric information and asymmetric information. The analysis of these simple situations provides us with the basic benchmark for our later analysis of middle management.

Symmetric information First suppose that all the parties know which project is realized. In this case hierarchy is not strictly more desirable than centralization. Under centralization, while B always proposes a project, T decides to implement the project if and only if it is project 1. Under hierarchy, B always proposes a project and M proposes the project if and only if it is either project 1 or 2. T only ratifies the implementation of project 1. Under either structure, the expected payoff to T is $\beta\gamma\overline{v}$, and T is not better off by adopting hierarchy. There is no role for middle managers.

Asymmetric information Next suppose there is asymmetric information in the sense that

only B knows which project is realized. T and M only know the probability distribution of project realization. It turns out even in this case hierarchy is not strictly more desirable than centralization. To see this, first consider the two-tier structure. T decides to implement the proposed project if the expected payoff is at least as large as the payoff under no project implementation (zero):

$$\beta\gamma\overline{v} - \beta(1-\gamma)\underline{v} - (1-\beta)\underline{v} = \beta\gamma\overline{v} - (1-\beta\gamma)\underline{v} \geq 0. \quad (1)$$

Hierarchy cannot attain the expected payoff higher than this. M proposes the project if his expected payoff is at least as large as zero:

$$\beta\gamma\overline{v} + \beta(1-\gamma)\overline{v} - (1-\beta)\underline{v} = \beta\overline{v} - (1-\beta)\underline{v} \geq 0.$$

However, even if M proposes the project, T makes her decision based on the stricter criteria (1). T's expected payoff is hence

$$\max\{\beta\gamma\overline{v} - (1-\beta\gamma)\underline{v}, 0\},$$

regardless of the two-tier or three-tier structure.

Two premises The reason why hierarchy is not strictly preferred is that T's information does not change with organizational structures. When information is symmetric, T knows the project fully. When information is asymmetric, T does not have any information about the project. The organizational structure does not affect T's information.

The organizational structure can matter if information content changes with structures. Although there is no room to improve T's payoff under symmetric information, under asymmetric information, T could increase her expected payoff if more information is available at the time when she decides to ratify project implementation.

There are two implicit premises behind the irrelevance results shown above. First, both T and M have the identical information gathering capabilities. Since M specializes more in management of B, it is likely for M to have more information than T.

The second premise concerns M's communication. While T obtains information directly from B under centralization, she obtains information via M under hierarchy. T's information should be affected by this difference in communication structures as well.

IV. Two Functions of Middle Managers

In this section we relax two premises discussed at the end of the previous section and point out two functions of middle management, monitoring and communication. To exclude inessential cases from the analysis, we assume

$$\beta\gamma\overline{v} - (1-\gamma\beta)\underline{v} < 0 \text{ and } \beta\overline{v} - (1-\beta)\underline{v} < 0. \quad (2)$$

The first condition implies T decides not to implement the project if she has no information,

while the second one implies M does not propose the project if he has no information about the project proposed by B. Note that the second condition is in fact sufficient for the first one. We state both conditions for convenience.

1. Monitoring

For the moment we assume M does not engage in communication, and only relax the assumption that "both T and M have the identical information gathering capabilities." To introduce their different information gathering capacities, we modify the model as follows. Under the two-tier structure T inspects B's proposed project to obtain information. With probability $s_T > 0$, she receives information that perfectly reveals which of three possible projects is proposed, while with $1 - s_T > 0$, she obtains information of no value. Based on the information received T decides whether or not to implement the project proposed by B. Under the three-tier structure, M engages in information gathering similar to what T does under the two-tier structure. However, M learns the realized project perfectly with probability $s_M > 0$ and learns nothing with probability $1 - s_M > 0$. M then decides whether or not to propose the project to T, and T makes the ratification decision. We treat s_M and s_T exogenous parameters and call them information gathering/monitoring capabilities of M and T, respectively.

With this modification the expected payoff differs possibly between centralization and hierarchy, due to the differences in information gathering capabilities. First consider centralization in which T gathers information. If T learns the project perfectly, she decides to implement it if and only if it is project 1. If T learns nothing, then by assumption (2) she ratifies no project. The expected payoff under centralization is thus

$$s_T \beta \gamma \overline{v}. \tag{3}$$

Next consider hierarchy. If M learns the proposed project perfectly, he proposes it to T if and only if it is either project 1 or 2. If M learns nothing, he does not propose any project by assumption (2). Based on this proposal, T decides whether or not to implement the project. Since T only knows that the proposed project is either 1 or 2. She hence decides to implement it if and only if

$$\gamma \overline{v} - (1 - \gamma) \underline{v} \geq 0 \tag{4}$$

holds. The expected payoff under hierarchy is hence

$$s_M \beta \max\{\gamma \overline{v} - (1 - \gamma) \underline{v}, 0\}. \tag{5}$$

Comparing the expected payoffs (3) and (5) yields the following result.

Theorem 1. *Suppose that only the member directly above B can gather information about the proposed project and that condition* (2) *holds. The expected payoff is strictly higher under hierarchy than under centralization if and only if the following condition holds:*

$$(s_M - s_T)\beta\gamma\overline{v} > s_M\beta(1-\gamma)\underline{v}. \quad (6)$$

The condition implies that hierarchy has an advantage over centralization if the benefit from better monitoring (the left-hand side of [6]) exceeds the cost from "loss of control" (the right-hand side). For the condition to hold, it is necessary for hierarchy to have better monitoring capabilities than centralization ($s_M > s_T$), which is likely to hold as M specializes in management of B. Since M does not propose project 3, his proposal is more aligned with T's interest than B's proposal under centralization. The left-hand side is hence equal to $\overline{v}$, the benefit from the implementation of project 1, multiplied by $(s_M - s_T)\beta\gamma$, the increment of the probability that project 1 is implemented.

However, there is the cost from loss of control under hierarchy. Adopting the three-tier structure precludes T from directly learning about the project realization, and hence T can only evaluate the proposed project in terms of conditional expectation. Since T and M's objectives are not perfectly aligned, T sometimes suffers from the implementation of undesirable project 2. The cost from this loss of control is equal to $s_M\beta(1-\gamma)\underline{v}$, the expected loss from the implementation of project 2, which is also the right-hand side of (6).

2. Communication

Up to this point we have assumed that although M receives information about the project, only the indirect information "the project is not 3" is transmitted to T via M's proposal. We now introduce M's communication function explicitly. The decision making process in hierarchy is now given as follows: (i) B learns project realization and proposes the project to M; (ii) M reports about the project if he receives perfect information, while he does not report otherwise; (iii) Based on the report T decides whether or not to implement the project. We also assume the following communication structure. M can transmit correct information for free. However, by spending cost $cx^2/2$ (where c is a positive constant), M can distort the report such that the correct information is transmitted only with probability $1-x$, and with probability x no information is transmitted to T.[1] An example of such a cost is that from drafting a sophisticated report, which must be written so as to confuse T about the realized project. Parameter c can be interpreted as the degree to which the organization's communication process is standardized. The better specified the format of the report is, the more difficult it is for M to make up such a subtle report.

The special case of $x = 0$ implies that M always reports truthfully, and $x = 1$ is the extreme case where correct information is never transmitted. Under the intermediate case of $0 < x < 1$, the report is partially distorted toward M's favor.

[1] This formulation is a simplified version of the standard cheap talk model originally attributed to Crawford and Sobel (1982). Although the cost from imprecise report is exogenous in our model, it can be endogenized by making T's decision variable continuous and looking for mixed strategy equilibria where correct information is transmitted only with some probability. Kartik, Ottaviani, and Squintani (2007) also analyze communication by introducing an exogenous cost of telling a lie.

To exclude uninteresting cases from the analysis, we assume $\gamma\overline{v}-(1-\gamma)\underline{v} \geq 0$, which implies that under hierarchy T decides to implement the project even if she does not learn anything from the report (see [4] in the previous subsection).[2]

Proposition 1. *Suppose that only the member directly above B can gather information about the proposed project and that M sends a report about the project to T under hierarchy. Suppose further that conditions* (2) *and* (4) *hold. Then M chooses the following* x^**contingent on the realized project proposed by B. If project* 1 *or* 3 *realizes, then M's report is truthful (*$x^* = 0$*). If project* 2 *realizes, M chooses* $x^*(c)$ *which is defined as follows:*

$$x^*(c) = \begin{cases} 1 & if\ \overline{v} > c \\ \overline{v}/c & if\ \overline{v} \leq c \end{cases}$$

T's expected payoff is then given as follows.

$$s_M\beta(\gamma\overline{v} - (1-\gamma)x^*(c)\underline{v}) \geq 0.$$

The proposition implies that while M's communication function is not perfect, it improves the performance of the hierarchy. There is an incentive problem in communication when project 2 is discovered. M prefers to implement the project while T wants to implement no project. The precision of M's report then is determined by the tradeoff between the marginal benefit $\overline{v}$ from increasing the probability of implementing project 2 and the marginal cost *cx*. As *c* is larger and hence the marginal cost of distorting information is higher, the probability of imprecise communication decreases. The implementation of project 2 is then less likely and T's expected payoff is higher. Communication reduces the cost from loss of control.

Based on Proposition 1, we can compare the expected payoffs to T between hierarchy and centralization, and obtain the following result.

Theorem 2. *Suppose that only the member directly above B can gather information about the proposed project and that M sends a report about the project to T under hierarchy. Suppose further that conditions* (2) *and* (4) *hold. The expected payoff is strictly higher under hierarchy than under centralization if and only if the following condition holds:*

$$(s_M - s_T)\beta\gamma\overline{v} > s_M\beta(1-\gamma)\,x^*(c)\,\underline{v} \tag{7}$$

Comparing condition (7) with (6) in the previous theorem 1 reveals that the right-hand side decreases and hierarchy is more likely to be optimal. This is because the correct information is communicated with probability $1 - x^*$ and hence the cost from loss of control is reduced. However, if cost parameter *c* is sufficiently small ($c < \overline{v}$), M has no

[2] We omit the proof of Proposition 1 as well as the analysis for the case of $\gamma\overline{v} - (1-\gamma)\underline{v} < 0$. Interested readers should contact the authors.

incentive to report truthfully ($x^* = 1$), and hence conditions (6) and (7) coincide.

3. Conditions for Middle Management

The advantage of hierarchy rests on monitoring and communication by the middle manager with high information gathering capacities. Hierarchy is costly, however, because the top loses direct control over the bottom.

We now discuss the roles of the middle manager and the conditions for utilizing middle management, based on Theorem 2. Table 3 summarizes project implementation under each organizational structure.

First, for hierarchy to be more desirable than centralization, the middle manager must have higher information gathering/monitoring capacities than the top ($s_M > s_T$). Only the manager who has higher abilities to collect information about the bottom can perform effective monitoring functions—proposing project 1 while rejecting project 3—to improve the performance of the organization. Without such capacities hierarchy is only costly due to loss of control. In fact, if $s_M = s_T$ holds, then the left-hand side of condition (7) in Theorem 2 becomes zero and hence the condition is not satisfied.

Second, the middle manager must be able to send appropriate information to the top. Hierarchy is more likely to be optimal as the probability that the middle manager sends correct information is higher (x^* is lower) and hence project 2 is less likely to be implemented. In particular, the communication process must be sufficiently standardized (c sufficiently large).

The third condition is that the interests of the middle manager and the top must be sufficiently congruent. As γ is higher and hence the preferences over the projects are more aligned, the conflicting project 2 is less likely to be implemented, and the loss of control in hierarchy is less damaging. Careful screening of managers at the time of recruiting, and/or introduction of performance-based pay could partially alleviate the conflict of interest.[3]

Let us repeat two main points we have made so far. (a) There is no role for the middle manager if he does not have an advantage in gathering information over the top. (b) If he has an advantage, the middle manager serves monitoring and communication functions.[4]

[3] Of course, being excessively loyal to the boss can bring negative effects into the organization, such as "yes men" who do not send valuable but unpleasant information to the boss (Prendergast and Topel 1993). This "yes men" problem is theoretically similar to the problem of the distorted information we study, and there is a conflict of interest behind the problem.

[4] In this paper we derive these two results from the incomplete contracting framework in which internal incentive schemes are abstracted away. Similar results can be obtained in the complete contracting framework. See Baron and Besanko (1992), Gilbert and Riordan (1995), McAfee and McMillan (1995), Melumad, Mookherjee, and Reichelstein (1992, 1995), and Mookherjee and Tsumagari (2004) for the communication function, Baliga and Sjostrom (1998) and Mookherjee and Tsumagari (2004) for the monitoring function, and Mookherjee (2006) for an overview.

Table 3. Organizational Structures and Project Implementation

	With information (s_T or s_M)			No information
	Project 1	Project 2	Project 3	
Centralization	Do	Not	Not	Not
Hierarchy (no communication)	Do	Do	Not	Not
Hierarchy (with communication)	Do	Do with pr. $x^*(c)$	Not	Not

V. The Middle Manager's Dilemma

We have so far focused on the middle manager's functions that help the top make a final implementation decision. In this relationship with the top, the more the middle manager performs the monitoring and communication functions, the better the top's decision is and hence the higher organizational payoff she can attain.

However, the roles of middle managers in the Japanese firm are typically more complicated. It is often said that a stylized feature of the Japanese firm is in its organization emphasizing initiatives from the bottom, and hence the middle managers are supposed to play important roles for managing the bottom. For example, Kagono et al. (1985) show based on their survey data that while American firms tend to design hierarchical organizations that fit corporate strategies, Japanese firms tend to adopt flexible structures that tolerate initiatives and fine-tuning from the bottom. More recently, Numagami et al. (2007) argue that "the emergent strategies and organizations that create new products and businesses through dense interactions among middle managers at the group's basis have been the essence of the strength of the traditional Japanese firm" and this idea "has long been supported by researchers of the Japanese firm."

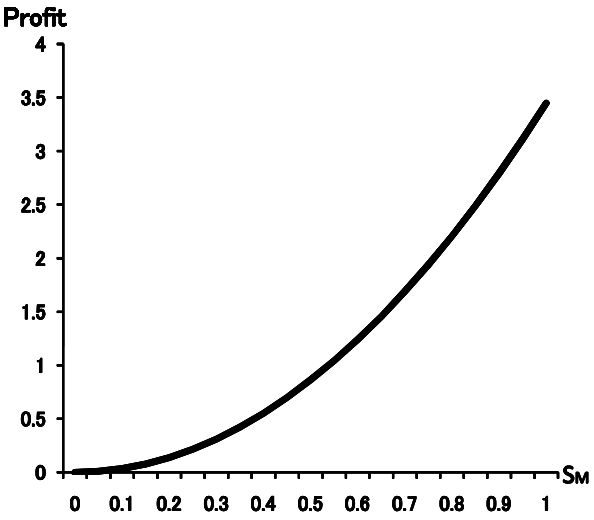
In this section, we introduce initiatives at the bottom into the model, and examine the middle manager's roles when such initiatives are important. B chooses effort (initiative) e with cost $de^2/2$ (where d is a positive constant). B then finds a new project with probability e but cannot find any project with probability $1 - e$. If B cannot find a project, there is no other decision and the payoffs are zero for T and M, and $-de^2/2$ for B. If B finds a project, the rest of the process is the same as before, as in Table 3.

Under hierarchy, project 1 is always implemented while project 2 is implemented with probability $x^*(c)$. The expected payoff to B is given as

$$es_M\beta[\gamma + (1-\gamma)x^*(c)]\overline{v}_B - \frac{de^2}{2}.$$

By the first-order condition, the optimal initiative is solved as follows:

$$e^H(c) = \frac{s_M\beta\left(\gamma + (1-\gamma)x^*(c)\right)\overline{v}_B}{d}.$$



(x^* = 0.6, s_T = 0.169 , β = 0.3, γ = 0.6, d = 1, $\overline{v}$ = 10, $\underline{v}$ = 6, v_B = 0.98)

Figure 1. Monitoring Capacity s_M and the Expected Payoff

The optimal initiative is increasing in the middle manager's monitoring capabilities s_M. Since B's incentive to take the initiative is stronger as his proposed project is more likely to be implemented, M's high ability to learn which project is realized is desirable for B as well.

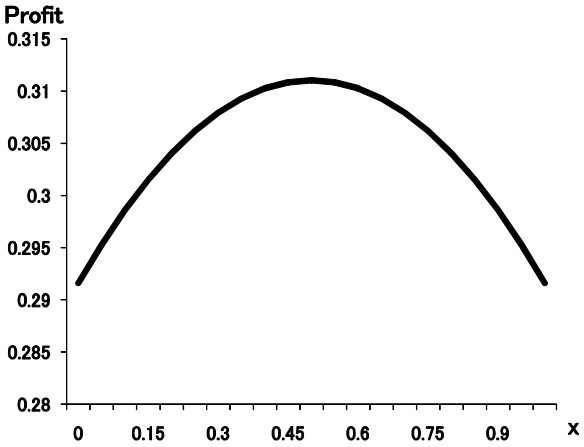
On the other hand, B's incentive is weaker as the middle manager's communication is more precise ($x^*(c)$ is lower). Since the role of the communication from M to T is to prevent project 2 from being implemented, communication has a negative effect on the likelihood of project implementation, which fact hinders B's initiative. We thus obtain the following result.

Theorem 3. *Suppose that only the member directly above B can gather information about the proposed project and that M sends a report about the project to T under hierarchy. Suppose further that conditions* (2) *and* (4) *hold. B's optimal initiative is higher as M's information gathering capacities (s_M) are higher or communication from M to T is less precise ($x^*(c)$ is larger).*

T's expected payoff is calculated as follows:

$$e^H(c)s_M\beta[\gamma\overline{v} - (1-\gamma)x^*(c)\underline{v}]. \tag{8}$$

Figure 1 shows the relationship between M's information gathering/monitoring capacities s_M and the expected payoff to T, which is monotone increasing: M's better expertise to gather information about the project benefits the organization. This monotone relationship is due to two positive effects. First, as we have pointed out in IV. 1, better mo-



(s_T = 0.169, s_M = 0.3, β = 0.3, γ = 0.6, d = 1, $\overline{v}$ = 10, $\underline{v}$ = 6, v_B = 0.98)

Figure 2. Communication Failure x^* and the Expected Payoff

nitoring prevents unprofitable project 3 from being implemented and increases the likelihood that M proposes a project aligned with T's interest. Second, better monitoring increases B's incentive to take the initiative, as we have shown in Theorem 3.

Figure 2, on the other hand, plots the relationship between the probability of communication failure x^* and the expected payoff to T. Now better communication (x^* approaching to zero) does not improve the expected payoff to the organization. This non-monotonic relationship is due to two conflicting effects. We have pointed out in IV. 2 that better communication reduces the probability of implementing project 2 and increases the expected payoff. However, better communication has a negative effect on B's initiative because the project proposed by B is less likely to be implemented. It is sometimes of value to the organization as a whole that the middle manager raise the bottom's incentive to take the initiative rather than pursue better communication.

Here comes the middle manager's dilemma. After B discovers a project, it is best for M to help T implement only the profitable project. However, to increase the ex ante incentive of B to take the initiative, M should have T implement a project more often, even if the expected payoff is negative, by not revealing the realized project. A subtle balance is demanded.

This dilemma offers an explanation for the problem in Omron we explain in the Introduction. In that case, the performance of some sections improved after the managers took leave. This can be understood as the situation where the managers engaged in excessive information transmission and discouraged the subordinates' incentives before they took their leave. The problem was mitigated by their absence through increase in the subordinates' initiatives.

VI. Initiatives at the Bottom and Japanese Management

In this section we analyze the optimal organizational structure given that B takes the initiative. As Table 3 shows, under centralization only project 1 is implemented given that T has perfect information. B's expected payoff is then given by

$$es_T\beta\gamma\overline{v}_B - \frac{de^2}{2}.$$

The first-order condition yields the optimal initiative under centralization:

$$e^C = \frac{s_T\beta\gamma\overline{v}_B}{d}.$$

Two features are worth noting. First, the optimal initiative under centralization does not depend on M's characteristics (s_M, x^*, c). Second, if M has higher monitoring capabilities than T ($s_M \geq s_T$), then B's optimal initiative is lower under centralization than under hierarchy ($e^H \geq e^C$). This is because the project proposed by B is more likely to be implemented under hierarchy when $s_M \geq s_T$ (see Table 3).

Using e^C, we can obtain the expected payoff to the centralized organization as

$$e^C s_T \beta\gamma\overline{v}. \tag{9}$$

Comparing (9) with (8) yields the following result.

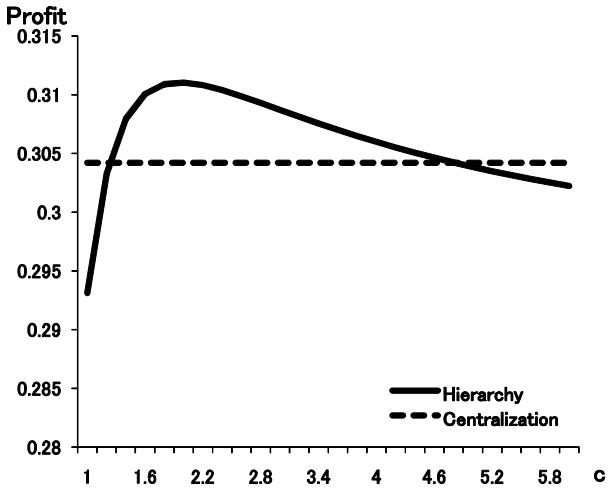
Theorem 4. *Suppose that only the member directly above B can gather information about the proposed project and that M sends a report about the project to T under hierarchy. Suppose further that conditions* (2) *and* (4) *hold. The expected payoff is strictly higher under hierarchy than under centralization if and only if the following condition holds:*

$$(e^H s_M - e^C s_T)\beta\gamma\overline{v} > e^H s_M \beta(1-\gamma)\, x^*(c)\, \underline{v}$$

Similar to Theorems 1 and 2, the tradeoff between the benefit from monitoring (the left-hand side) and the cost from loss of control (the right-hand side) determines the optimal organization. The difference from the previous results is that B's initiative matters for the comparison, since no project is implemented, regardless of the organizational structure, if B does not find a new project.

The theorem suggests that the middle managers have another important role of managing initiatives at the bottom. In fact, even if M has no advantage in terms of information gathering ($s_M = s_T$), hierarchy may become optimal.[5] Project 2 is more likely to be

[5] Substituting $s_M = s_T$ into the condition in the theorem yields $\frac{\gamma}{\gamma+(1-\gamma)x^*(c)}\overline{v} \geq \underline{v}$.



(s_T = 0.169, s_M = 0.3, β = 0.3, γ = 0.6, d = 1, $\overline{v}$ = 10, $\underline{v}$ = 6, v_B = 0.98)

Figure 3. Standardization c and the Expected Payoff

implemented under hierarchy than under centralization, and hence B's initiative increases ($e^H > e^C$). Since this increase in B's initiative in turn raises the likelihood that project 1 is discovered, hierarchy may generate a higher expected payoff than centralization. In other words, the middle manager raises incentives at the bottom exactly because he makes information transmission to the top difficult. It is often the case that IT investment does not affect the ratio of middle managers in the Japanese firm (Sato 2004). This finding is consistent with our result because the middle managers' role of motivating the bottom survives even though IT might reduce the information gap between the top and the middle managers.

Furthermore, Theorem 4 helps us understand stylized features of traditional Japanese management. Kagono et al. (1985) find that (a) managers lower than business unit managers have more influence on strategic decision making in the Japanese firm than in their U.S. counterparts; and (b) the organizational structure of the Japanese firm is less formalized/standardized than the U.S. firm. Here standardization is measured by the ratio of the firms adopting administrative systems like investment analysis, sales forecasting, and planning systems.

Our results are consistent with these findings. According to Theorem 4, hierarchy is preferred to centralization in terms of initiatives at the bottom ($e^H > e^C$). The Japanese firm that emphasizes initiatives at the bottom is hence more likely to adopt the organizational structure with more influence of the middle and bottom managers.

Furthermore, intermediate standardization in communication is desirable under hierarchy (c in the middle range). Figure 3 shows the relationship between the degree of standardization measure by c and the expected payoff to the organization. The expected payoff

is not monotone increasing in standardization. This corresponds to our middle manager's dilemma. If the communication is very standardized, it is very difficult for M to make up a subtle report, and hence M's report is very likely to reveal the project truthfully. The project is then less likely to be implemented, and hence the initiative at the bottom is undermined. If the "less formalized/standardized" structure of the Japanese firm implies "intermediate standardization in communication," then this feature can be understood as a way to keep initiatives at the bottom high, as our results suggest.

VII. Summary

Although it is often said that the strength of the stylized Japanese firm is in the emergent strategies based on initiatives at the lower-tier workers/managers, the analysis of organizational structures encouraging such initiatives has been scarce. In fact, Numagami et al. (2007) argue the need for research on organizational structures of the Japanese firm:

> Research on important organizational problems, in particular, those detrimental to the emergent strategies, has been underdeveloped in Japan. We strongly believe that when the performance of the Japanese firm was sound during the 1980s, many business researchers did not realize the problematic perception that "the organizational structure of the Japanese firm is good at performing day-to-day operations." ... Despite the possibility that good environments explain most of the high performance, neither Japanese firms nor researchers could escape from the misperception that the Japanese firms represented by Toyota were excellent and were in good condition. (pp. 13-14)

In this paper we summarize existing literature on hierarchy in organizational economics and analyze the roles of middle management and their relationships with organizational structures, in particular, by introducing "initiatives at the bottom" that have been emphasized by Japanese firms.

Setting up and analyzing a simple model of the organization that consists of top, middle, and bottom, we first show two functions of middle management, monitoring and communication. We then argue that the relationships between these functions and the organizational performance are monotonic: The more the middle manager performs the monitoring and communication functions, the better the top's decision is and hence the higher organizational payoff she can attain.

However, two features of the stylized Japanese firm in comparison with the U.S. firm are hard to explain: (a) lower-level managers have more influence on strategic decision making than business unit managers over their U.S. counterparts; and (b) the organizational structure of the Japanese firm is less formalized/standardized. More influence of middle management along with low standardization simply increases costs from "loss of control" and harms the organizational performance.

We thus introduce "initiatives at the bottom," an important feature of the Japanese firm, into the model and show that what we call the middle manager's dilemma arises. Better communication is not necessarily more desirable for the organization. The middle manager should sometimes refrain from communication in order to increase the incentives of the bottom to take the initiative. Two features of the Japanese firm mentioned above can be understood as those encouraging initiatives at the bottom.

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