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Abstract

This paper studies how superiors' effort combines with incentive pay to motivate subordinates' effort. We develop a principal–agent model that distinguishes the superior's effort into two kinds: monitoring, aimed at checking the subordinate's behavior, and supervision, aimed at enhancing his productivity. We test its implications using observations on store managers and their subordinate department managers from a large retailer. The evidence is broadly consistent with the model's predictions: monitoring and incentive pay interact negatively in generating sales performance, whereas supervisory effort and incentive pay interact positively. Our study underscores the importance of distinguishing the principal's effort in settings where incentive pay motivates agent effort.

Keywords: Incentive pay; monitoring; supervision; managerial effort; Japanese retail; agency theory.

*We thank Heikki Rantakari for working on an earlier theoretical model.

1 Introduction

Managers inside firms rely on more than one instrument to motivate effort. A superior can monitor and check on a subordinate's effort, become productively involved in the subordinate's work, or provide incentive pay. These instruments are common, but their interaction is not obvious. Classic efficiency wage theory argues that monitoring may make incentive pay less necessary if the threat of detection already disciplines the subordinate. Yet monitoring and supervisory involvement may also make pay more effective by improving information about behavior, guiding what the subordinate should do, and increasing the value of cooperation. The same observed practice when a superior spends time with a subordinate can, therefore, have different economic and managerial implications.

This paper studies the interaction between the superior's effort and compensation in a within-firm setting. The empirical context is a large Japanese retailer in which department managers differ in the attention they receive from superior managers, in the share of variable pay in total compensation, and in sales and effort outcomes. The setting is useful because superior effort can be separated into monitoring hours and supervisory hours. Monitoring hours capture the disciplinary and information-gathering role of the superior. Supervisory hours capture productive involvement such as coaching, guidance, and support that may raise the return to subordinate effort. This separation is central to the paper. If these two roles are pooled into a single measure of the superior manager's attention, the interaction between the superior's effort and incentive pay offered to subordinates would be ambiguous.

The theoretical starting point is a familiar tension in economics and management. Efficiency-wage models treat monitoring and compensation as substitute instruments for eliciting effort (Becker and Stigler, 1974; Shapiro and Stiglitz, 1984; Roberts, 2004). If effort and behavioral deviations are more likely to be detected, a lower compensation premium may be enough to induce compliance. At the same time, relational-contract and personnel-economics arguments emphasize that incentives are embedded in ongoing relationships (Baker, Gibbons, and Murphy, 2002; Macchiavello, 2022). Superior involvement may improve the informational and productive environment in which incentives operate. Empirical work on supervisors and managers similarly shows that bosses can raise worker output through coaching, assignment, and people-management skills rather than monitoring alone (Lazear, Shaw, and Stanton, 2015; Hoffman and Tadelis, 2021).

To reconcile these views, we develop a principal-agent model in which the principal chooses monitoring effort, supervisory effort, and incentive pay to motivate the agent to provide unobservable effort and hence to achieve a sale. The production function is flexible enough to treat the principal's supervisory effort as a technological complement or substitute

to agent effort. In our model, supervisory effort affects output only through its interaction with the agent's effort, while monitoring affects the probability of the principal observing the agent's effort. This formulation deliberately separates the principal's roles of detection (i.e., monitoring) from productive involvement (i.e., supervision) in motivating agent effort.

The main predictions of our model are about the interactions between incentive pay and each of the two kinds of superior effort. It predicts that supervisory effort and incentive pay are complements in motivating agent effort and achieving the sale. Monetary incentives motivate agent effort, and the agent becomes even more reactive to the incentive when he expects the principal's supervisory effort to be higher. Monitoring effort raises agent effort by making the principal more likely to respond with supervision for *observed* agent effort when supervision is technologically complementary with agent effort. However, the interaction between monitoring and incentive pay can be negative when incentive pay is high. This is because high-powered incentive pay reduces the principal's motivation and responsiveness to provide supervisory effort. As such, our model predicts that the sign of the interaction depends on the role of the superior's effort.

We take these predictions to department-level data from a large Japanese retailer. The analysis uses observations from department managers ("subordinates" or "the agent") who report to their respective store managers and senior managers ("superiors" or "the principal"). To match our theoretical model, the main outcomes are agent effort and sales performance. The key explanatory variables are superiors' monitoring hours, superiors' supervisory hours, and the subordinate manager's share of variable pay.

The descriptive evidence suggests that managerial involvement matters: high-supervision and high-monitoring department managers tend to spend higher effort than their low-involvement counterparts across much of the incentive-pay distribution. In OLS regressions, where the interpretation is correlational, the interaction between monitoring and incentive pay is negative, while the interaction between supervision and incentive pay is positive. Corrected with instrumental variables for incentive pay and the two kinds of superior effort, the control-function specifications preserve the same basic asymmetry, especially in the sales performance analysis. As such, these results provide support for our theory, in particular under the case when the supervisory effort and agent effort are technological complements in the production function. In comparison, when our analysis lumps superior effort together as a single variable, those two interaction terms are tiny and statistically not significant. These results show the importance of treating distinctively superior's monitoring and supervisory efforts when incentive pay is involved in motivating subordinates.

Our paper makes two main contributions. First, it contributes to work on monitoring and compensation by showing why the simple monitoring-pay trade-off is incomplete. Monitoring

can detect effort, but superior involvement can also affect the marginal productivity of subordinate effort. Second, it contributes to the growing micro-evidence in the empirical literature on middle-level managers by using within-firm data to distinguish what managers do, in addition to how much time they spend.

The paper proceeds as follows. Section 2 reviews the relevant literature. Section 3 summarizes the institutional context in which we test our theory. Section 4 presents the model and its predictions. Section 5 describes the data and variables. Section 6 reports the empirical results. Finally, section 7 concludes.

2 Related Literature and Conceptual Distinctions

The paper builds on the literature on principal-agent effort and incentives. In standard moral-hazard models, formal incentives motivate effort when effort or output is imperfectly observed (Holmstrom, 1979). The personnel economics literature examines how firms combine pay, monitoring, and job design to influence worker behavior (Lazear and Oyer, 2012). Efficiency-wage models add the idea that compensation can serve as a rent that workers lose if shirking is detected (Becker and Stigler, 1974; Shapiro and Stiglitz, 1984). In this logic, superior's monitoring of and pay to the subordinates often substitute for one another: better detection reduces the wage premium required to discipline effort. Allgulin and Ellingsen (2002), however, show in their theoretical model that the relationship is more tenuous and need not be globally monotone, because cheaper monitoring may also lead the firm to implement higher effort.

Importantly, the theoretical literature does not distinguish the kind of superior effort. As we show in the theoretical model below, the relationship between incentive pay and superior effort critically depends on the nature of the effort: monitoring versus supervision. Monitoring is about the superior's checking and policing her subordinate's behavior and performance, whereas supervision is about teaching and guiding and is, hence, productivity-enhancing for the agent. As a key contribution of our study, our model and empirical analysis treat them differently.

A second line of literature studies the role of managers and their superiors within firms. Work on formal and real authority emphasizes that organizational instruments differ depending on whether they allocate information, decision rights, or incentives (Aghion and Tirole, 1997). Empirically, Lazear, Shaw, and Stanton (2015) show that supervisors differ substantially in their productivity effects, partly through teaching and coaching. Hoffman and Tadelis (2021) show that people-management skills affect employee outcomes. Bandiera, Barankay, and Rasul (2007) demonstrate that managerial incentives affect how managers

allocate effort across workers. Related evidence shows that team incentives can raise performance in retail settings (Friebel et al., 2017), while information about relative pay can change worker effort and career expectations (Cullen and Perez-Truglia, 2022). Sandvik et al. (2020) show that knowledge-sharing interventions can raise sales, while Sandvik et al. (2021) show that compensation changes can affect both effort and sorting. These studies refine the treatment of superior effort and relate to our separation between disciplinary monitoring and productive supervision.

The empirical context is part of a broader organizational-economics research that uses within-firm micro-level data to examine how managers allocate attention, authority, and effort. The present paper asks a specific question within that broader agenda: when do superior effort and incentive pay reinforce each other, and when do they substitute for one another?

It is useful to be explicit about terminology. Two instruments are complements with respect to an outcome if an increase in one raises the marginal effect of the other on that outcome. They are substitutes if an increase in one lowers the marginal effect of the other. A technological relationship refers to the production function (Beattie and Taylor, 1985): in our setting, superior effort and subordinate effort are technological complements when more superior effort increases the marginal product of subordinate effort. Finally, strategic complements and substitutes refer to optimal responses: two variables are strategic complements if increasing one makes it optimal to increase the other (Tirole, 1988). The paper's main point is that these notions need not coincide. Monitoring may be technologically distinct from supervision, and the two kinds of superior effort may generate different interaction effects with compensation to generate an outcome, possibly complements or substitutes.

3 Institutional Context

This section provides a summary of the company from which we collected the data and a description of its stores' business and management practices.

3.1 The company and the stores

Japan is one of the largest retail markets in the world. In 2025, retail trade sales in Japan were approximately ¥157 trillion, or roughly USD950 billion, according to the Ministry of Economy, Trade and Industry's Current Survey of Commerce (METI). The focal company is a major Japanese retailer that operates a portfolio of retail formats nationwide. Our data cover over 300 stores located throughout Japan. These stores are best understood as general

merchandise retailers. Under the North American Industry Classification System, the closest broad category is NAICS 455, General Merchandise Retailers. Comparable formats include large multi-category retailers in the United States such as Walmart, Target, Costco, and Macy's, and European chains such as Carrefour and Auchan. The stores in our sample are large operating units: they occupy substantial floor space, employ hundreds of workers, and serve thousands of customers on a typical operating day.

The store and its managers constitute the relevant organizational unit in our analysis. The store manager has overall responsibility for store performance. Working together with the store manager, several senior managers oversee major functions such as sales, merchandising, operations, marketing, personnel, and store administration. Each store contains up to 24 departments, each headed by a department manager who reports to the store's management team. Department managers oversee lower-level workers, respond to local demand conditions, implement store-wide policies, and adjust daily operations, including pricing and shelf space, in response to sales performance, customer traffic, inventory conditions, weather, promotions, and local competition. The clear division of labor and hierarchical relationship between store-level management and department managers suggest that their efforts are technological complements. In our analyses, the department manager is the unit of analysis (the "focal manager"), while the senior managers and store manager are treated as the focal manager's "superiors."

The daily operation of these stores makes the distinction between monitoring and supervision empirically meaningful. Department managers do not work in isolation. They participate in regular meetings with the store manager and senior managers to review sales performance, budget attainment, inventory conditions, staffing needs, customer complaints, promotional campaigns, and operational issues. These meetings are partly informational: department managers report what is happening in their units, and superior managers compare these reports with sales records, budget targets, headquarters directives, and observed shop-floor conditions. In this sense, the meetings create opportunities for monitoring. Superior managers can assess whether department managers have implemented agreed actions, followed storewide standards, responded appropriately to deviations from plan, and maintained expected levels of effort.

The same interactions also have a supervisory role. Superior managers do not merely check what department managers have done; they also help them decide what to do next. They may advise department managers on how to adjust the assortment of merchandise, reorder inventory, review floor displays, schedule employees, respond to local customer flows, handle service problems, or coordinate promotions with other departments. For example, a promotion in apparel may require coordinated decisions about displays, staffing, checkout

flow, and customer service. A change in demand for prepared food may require coordination with grocery, daily food, produce, and staffing functions. In these cases, superior managers provide guidance, resolve conflicts, and help department managers translate storewide priorities into concrete actions within their units.

Shop-floor interactions further reinforce this dual role. Store managers and senior managers observe departments directly as they walk through the store, speak with department managers, inspect displays, review product availability, and follow up on operational issues. These visits allow superior managers to verify whether instructions and standards are being implemented. They also allow them to provide real-time advice. A superior manager may point out a display problem, suggest a different staffing arrangement, help interpret a sales shortfall, or coordinate a response to an unexpected increase in customer traffic. The same physical interaction can therefore contain both monitoring and supervision. What matters for our theory is not whether the activities occur in different places, but how much the superior's time is used (i) to detect and evaluate subordinate effort and (ii) to improve the productivity of that effort.

This institutional setting closely maps into the empirical measures used in the following. Monitoring hours from the boss capture time spent checking, observing, and evaluating department managers' actions. Supervisory hours from the boss capture the time spent guiding, coaching, coordinating, and helping department managers solve operational problems. The two forms of superior effort are related but not the same. Monitoring affects the likelihood that deviations from expected effort or behavior are detected. Supervision affects the production environment in which department managers exert effort. The Japanese retail setting is therefore well-suited to test the central implication of the model: incentive pay may interact differently with detection-oriented monitoring than with productive supervisory involvement.

4 The Model

4.1 Setup

Consider an organization in which a principal hires an agent to conduct a selling activity. In the vertical relationship in our institutional context, the store manager (together with her deputy, senior managers) can be viewed as the principal and the department manager as the agent. The main choice of the principal is to decide on the levels of her effort, namely, superior effort in terms of (i) monitoring, (ii) supervision, as well as the incentive intensity. Specifically, the principal chooses a monitoring effort $m \geq 0$, which costs m. After observing

m, the agent chooses effort e_A with cost $(1/2)e_A^2$. The principal observes the agent's effort e_A with probability $P(m) \in [0,1]$, but can observe nothing with probability $1-P(m)$, where $P(0) = 0$ and $P(m)$ is increasing in m. The principal then chooses a supervisory effort $e_P \geq 0$ with cost $(1/2)e_P^2$. Sales y is either 0 or 1, and $\Pr\{y = 1\} = e_A - be_Ae_P$ and $\Pr\{y = 0\} = 1 - (e_A - be_Ae_P)$. We interpret e_P as supervisory because e_P matters only if $e_A > 0$: e_P is not directly productive without the agent's effort, and the only role of e_P is to interact with the agent's effort.[1] If $b \geq 0$, e_A and e_P are technological substitutes, and if $b \leq 0$, they are technological complements. We assume $|b| < 1$. We also assume that the relevant parameter values are restricted such that $\Pr\{y = 1\} \in [0,1]$ holds.

The principal chooses a share rate $\alpha \in (0,1)$ of realized sales y as the incentive pay for the agent, and the principal's payoff is $(1-\alpha)y - (1/2)e_P^2 - m$. The payoff to the agent is $\alpha y - (1/2)e_A^2$.[2]

The timing is summarized as follows.

1. The principal offers contract (α, m) and requests e_A.
2. The agent either accepts or rejects the offer. The agent, if he rejects the offer, obtains the reservation payoff which is zero.
3. After accepting the offer, the principal chooses m.
4. The agent chooses e_A.
5. With probability $P(m)$, the principal observes e_A.
6. The principal chooses e_P.
7. The sales output y realizes and the payment is made.

4.2 Analysis: The Principal's Supervisory Effort Choice

We solve the model by backward induction. Suppose (α, m, e_A) are given. The principal observes e_A with probability $P(m)$, and chooses her best response:

$$e_P(e_A) = \max\{(1-\alpha)(-be_A), 0\},$$

[1] We could introduce the principal's productive effort in addition to (m, e_P).

[2] Introducing a fixed pay does not change the results as long as the participation constraint does not bind and thus the principal has to pay a rent to the agent.

which implies that $e_P(e_A) = 0$ if $b \geq 0$ (i.e., e_P and e_A are technological substitutes)[3] and $e_P(e_A) = (1-\alpha)(-be_A)$ if $b \leq 0$ (technological complements). The principal cannot observe e_A with probability $1 - P(m)$, in which case she chooses her best response to her belief $\tilde{e}_A$: $\tilde{e}_P = \max\{(1-\alpha)(-b\tilde{e}_A), 0\}$. The belief is correct in equilibrium: $\tilde{e}_A = e_A$.

The principal's supervisory effort and the agent's productive effort are strategic complements if and only if they are technological complements.

$$e'_P(e_A) = \frac{\partial e_P(e_A)}{\partial e_A} = (1-\alpha)(-b) \geq 0 \quad \text{for } b \leq 0,$$

where the inequality is strict for $b < 0$. Under technological complements, the smaller the principal's share $1 - \alpha$ is, the more reactive the principal is to the agent's effort e_A.

$$\frac{\partial e'_P(e_A)}{\partial \alpha} = \frac{\partial^2 e_P(e_A)}{\partial e_A \partial \alpha} = b \leq 0 \quad \text{for } b \leq 0.$$

4.3 Analysis: The Agent's Effort Choice

Suppose (α, m) are given. The agent chooses e_A to maximize

$$P(m)\alpha e_A(1 - be_P(e_A)) + (1 - P(m))\alpha e_A(1 - b\tilde{e}_P) - \frac{1}{2}e_A^2.$$

The first-order condition is given by

$$P(m)\alpha(1 - be_P(e_A)) + P(m)\alpha(-be_A)e'_P(e_A) + (1 - P(m))\alpha(1 - b\tilde{e}_P) - e_A = 0. \quad (1)$$

Note that the second-order condition is satisfied:

$$P(m)\alpha(-b)e'_P(e_A) + P(m)\alpha(-b)e'_P(e_A) - 1 \leq 2P(m)\alpha(1-\alpha)b^2 - 1 < 0.$$

If $b > 0$, then $e_P(e_A) = e'_P(e_A) = 0$ and hence

$$e_A(m, \alpha, \tilde{e}_P) = [1 - (1 - P(m))b\tilde{e}_P]\alpha. \quad (2)$$

Under technological substitutes, the agent's effort is increasing in α and decreasing in the belief $\tilde{e}_P$ of the uninformed principal's supervisory effort. In equilibrium, $e_A(\alpha) = \alpha$.

[3] This holds even if e_P is productive without the agent's effort ($\Pr\{y = 1\} = e_A - be_Ae_P + de_P$ with $d > 0$), as long as d is sufficiently small.

For $b < 0$, rewriting the first-order condition (1) yields

$$\begin{aligned} & P(m)\alpha[1 + 2(1-\alpha)b^2 e_A] + (1 - P(m))\alpha(1 - b\tilde{e}_P) - e_A \\ & = P(m)\alpha - [1 - 2P(m)\alpha(1-\alpha)b^2]e_A + (1 - P(m))\alpha(1 - b\tilde{e}_P) = 0 \\ & \iff e_A(m, \alpha, \tilde{e}_P) = \lambda(m, \alpha, \tilde{e}_P)\alpha, \end{aligned} \tag{3}$$

where

$$\lambda(m, \alpha, \tilde{e}_P) = \frac{1 - (1 - P(m))b\tilde{e}_P}{1 - 2P(m)\alpha(1-\alpha)b^2}. \tag{4}$$

Note that the denominator is always positive.

The agent's effort is increasing in $\tilde{e}_P$. Differentiating $e_A(m, \alpha, \tilde{e}_P)$ with respect to α yields

$$\frac{\partial e_A(m, \alpha, \tilde{e}_P)}{\partial \alpha} = \frac{1 - (1 - P(m))b\tilde{e}_P}{(1 - 2P(m)\alpha(1-\alpha)b^2)^2}\left(1 - 2P(m)\alpha^2 b^2\right), \tag{5}$$

which is positive and hence the agent's effort is increasing in α if $\alpha \leq \sqrt{2}/2$, or if $\alpha > \sqrt{2}/2$ and $P(m)$ and $|b|$ are sufficiently small.

In equilibrium, $\tilde{e}_P = e_P(e_A) = (1 - \alpha)(-b)e_A$ holds, and then $e_A(m, \alpha) = \lambda(m, \alpha)\alpha$, where

$$\lambda(m, \alpha) = \frac{1}{1 - (1 + P(m))\alpha(1-\alpha)b^2} > 1. \tag{6}$$

The principal's supervisory effort and monetary incentives

We examine how the principal's supervisory effort and incentive pay interactively affect the agent's effort. From (2) and (5), we find

$$\frac{\partial^2 e_A(m, \alpha, \tilde{e}_P)}{\partial \alpha \partial \tilde{e}_P} \begin{cases} < 0 & \text{for } b > 0; \\ > 0 & \text{for } b < 0. \end{cases}$$

Intuitively, the agent works harder as his monetary incentive is higher-powered. And the agent who expects the principal to choose a higher level of supervisory effort becomes less (more) responsive to the monetary incentive when these efforts exhibit substitutes (complements, respectively). Hence in the case of technological complements, the interactive effect of supervision and incentive pay on the agent's effort is positive, which in turn leads to the positive interactive effect on sales.

The principal's monitoring effort and formal monetary incentives

We next examine the interactive effect of monitoring and incentive pay on the agent's effort. To see how the agent's share α interacts with the principal's monitoring effort to affect his effort, we first assume $b < 0$ and differentiate the left-hand side of the first-order condition (3) for e_A with respect to α and $P(m)$, which yields $b(\tilde{e}_P + 2(1-2\alpha)be_A)$. While the sign generally depends on the agent's belief about the uninformed principal's supervisory effort, it is negative if $\alpha \geq 1/2$, irrespective of the belief. In equilibrium where his belief is correct, it is equal to $(1-3\alpha)b^2e_A$, which is negative if $\alpha > 1/3$. Intuitively, as explained above, the agent is motivated to increase his effort in response to the principal's higher monitoring effort in the case of complements. And this effect is amplified by the agent's stronger monetary incentive. However, the stronger the monetary incentive for the agent, the weaker the principal's incentive to exert supervisory effort, which attenuates the agent's motivation to raise his effort. If the agent's share rate is sufficiently large, the positive effect is dominated by the negative effect, leading to a negative interaction effect between monitoring and incentives on the agent's effort.

Finally, if $b > 0$, (2) shows that as the principal's monitoring effort is higher and thus she is more (less) likely to choose $\tilde{e}_P$ ($e_P(e_A) = 0$, respectively), the agent becomes *more* responsive to incentive pay. This effect, however, disappears in equilibrium where his belief is correct.

4.4 Analysis: The Principal's Monitoring Effort

We next analyze the principal's choice of monitoring effort, given α. How does e_A change with the principal's monitoring probability? If $b \geq 0$, $e_A(\alpha)$ is independent of m, and thus the principal has no incentive to exert costly monitoring effort ($m = 0$).

If $b < 0$, on the other hand, increasing her monitoring effort raises the probability that the principal observes and responds positively to the agent's effort in terms of her supervision. Hence, when the principal's monitoring effort is higher, the agent, who expects the principal's positive supervisory response to be more likely to follow, has a reason to raise his effort. However, (3) shows that whether or not the agent's effort is increasing in m generally depends on his belief regarding the uninformed principal's supervisory effort. When he correctly believes $\tilde{e}_P = (1-\alpha)(-be_A)$, the agent's effort is increasing in her monitoring effort by (6). With a higher probability of observation, the agent's effort choice is more likely to affect the principal's supervisory effort positively under technological complements, and hence the

agent raises his effort. The principal's expected payoff is given by

$$u_P = (1-\alpha)[e_A - be_A e_P(e_A)] - \frac{1}{2}e_P(e_A)^2 - m = (1-\alpha)e_A + \frac{1}{2}(1-\alpha)^2 b^2 e_A^2,$$

which is increasing in e_A. Hence, under technological complements, increasing m raises e_A, which benefits the principal.

Our empirical analysis will test the predictions on the effect of monitoring, supervision, and incentive pay-including the interactions of the former two variables with incentive pay-in the context of retail managers working for a major Japanese retailer. For completeness, we solve the optimal choice of α in the first stage in the following.

4.5 The Optimal Sharing: Case of Binary Monitoring Effort

We are now back to the first stage of the game where the principal chooses α. If $b \geq 0$, the principal does not monitor the agent's effort, and the agent chooses $e_A = \alpha$. Denote this effort by e_A^0 (effort under no monitoring). The principal's supervisory effort is $e_P = 0$.

The principal chooses α to maximize $u_P^0 = (1-\alpha)e_A^0 = (1-\alpha)\alpha$. The optimal share rate is $\alpha^0 = 1/2$. The expected payoffs to the principal and the agent are, respectively, given by $u_P^0 = 1/4$ and $u_A^0 = 1/8$.

For the rest of this subsection, we restrict attention to the case of technological complements ($b < 0$). To simplify the analysis, we assume binary monitoring effort $m \in \{0, C\}$, where $m = 0$ indicates "no monitoring" and $m = C$ "monitoring."

No Monitoring

First suppose the principal chooses $m = 0$, and thus $P(0) = 0$. The agent's effort and the principal's supervisory effort are given as follows

$$e_A^0 = \lambda(0,\alpha)\alpha = \frac{\alpha}{1-\alpha(1-\alpha)b^2}, \qquad e_P^0 = \frac{-\alpha(1-\alpha)b}{1-\alpha(1-\alpha)b^2}.$$

The principal chooses α to maximize

$$\begin{aligned} u_P^0 &= (1-\alpha)e_A^0 + \frac{1}{2}(1-\alpha)^2 b^2 (e_A^0)^2 \\ &= \frac{\alpha(1-\alpha)}{1-\alpha(1-\alpha)b^2}\left(1 + \frac{\alpha(1-\alpha)b^2}{2(1-\alpha(1-\alpha)b^2)}\right), \end{aligned}$$

which is increasing in $\alpha(1-\alpha)$. Since $\max \alpha(1-\alpha) = 1/4$, the optimal share is $\alpha^0 = 1/2$. The efforts and the expected payoffs are summarized as follows.

$$e_A^0 = \frac{1/2}{1-(1/4)b^2}, \qquad e_P^0 = \frac{-(1/4)b}{1-(1/4)b^2},$$

$$u_P^0 = \left(\frac{1/4}{1-(1/4)b^2}\right)\left(1+\frac{(1/4)b^2}{2(1-(1/4)b^2)}\right), \qquad u_A^0 = \frac{1/4}{2(1-(1/4)b^2)}.$$

Monitoring

We next consider the case where the principal chooses to monitor the agent's effort ($m = C$). Denote $P(C)$ by P and $Q = 1 + P$. The efforts are given as follows.

$$e_A^1 = \lambda(1,\alpha)\alpha = \frac{\alpha}{1-Q\alpha(1-\alpha)b^2}, \qquad e_P^1 = \frac{-\alpha(1-\alpha)b}{1-Q\alpha(1-\alpha)b^2}.$$

The principal chooses α to maximize

$$\begin{aligned} u_P^1 &= (1-\alpha)e_A^1 + \frac{1}{2}(1-\alpha)^2(-be_A^1)^2 - C \\ &= \frac{\alpha(1-\alpha)}{1-Q\alpha(1-\alpha)b^2}\left(1+\frac{\alpha(1-\alpha)b^2}{2(1-Q\alpha(1-\alpha)b^2)}\right) - C, \end{aligned}$$

which is increasing in $\alpha(1-\alpha)$. Since $\max \alpha(1-\alpha) = 1/4$, the optimal share is $\alpha^1 = 1/2$. The efforts and the expected payoffs are summarized as follows.

$$e_A^1 = \frac{1/2}{1-(Q/4)b^2}, \qquad e_P^1 = \frac{-(1/4)b}{1-(Q/4)b^2},$$

$$u_P^1 = \left(\frac{1/4}{1-(Q/4)b^2}\right)\left(1+\frac{(1/4)b^2}{2(1-(Q/4)b^2)}\right) - C,$$

$$u_A^1 = \frac{1/4}{2(1-(Q/4)b^2)}\left(1-\frac{1}{2}Pb^2\right).$$

Comparison

The principal's optimal choice of monitoring effort is summarized as follows.

1. There exists $\bar{C} > 0$ such that the principal chooses to monitor if $C < \bar{C}$.
2. There exists $\bar{Q} \in (1,2]$ such that the principal chooses to monitor if $Q > \bar{Q}$.

3. There exists $\bar{B} \in (0, 1]$ such that the principal chooses to monitor if $b^2 > \bar{B}$. Monitoring is more likely as the degree of technological complementarities is higher.

5 Data, Measures, and Identification

The empirical analysis uses observations by department managers from a large Japanese retailer. This context suits our investigation of the incentive effects of managerial effort and compensation well. Japan is an advanced retail market: it is economically prominent and technologically sophisticated. Japan's retail sales totaled approximately ¥157.5 trillion (about $950 billion) in 2025, underscoring the sector's substantial economic scale. Japan also has sophisticated store-level retail systems, characterized by extensive use of item-level point-of-sale data, tightly coordinated logistics, and automated checkout technologies. Our retailer has adopted cashless payments and engaged in online business, in line with other leading Asian markets and ahead of average Japanese retailers (United Nations, 2024; METI, 2025). Yet managerial effort remains important because the company's brick-and-mortar stores carry an unusually large number of SKUs. This operating complexity requires department managers and their superiors to work on operational issues such as monitor inventory, shelf displays, promotions, staffing, customer service, and local conditions on a continuing basis.

Our retail company operates various retail formats throughout the country. Department managers have to perform five key selling tasks in their daily operations: pricing, merchandising, sales planning, product management, and personal selling.

The unit of observation is at the department-manager level. We call the corresponding person "the focal manager" so as to distinguish him from his superior managers. The estimation sample contains 2,871 observations in the main specifications. Our data came from two sources: (1) a company-wide survey instrument that measures effort levels exerted by the focal manager and his superiors, pay structure, experience, and individual manager's demographics and personality traits; and (2) monthly sales-to-sales-target information for each department. Since each department is uniquely managed by the department manager, departmental sales performance is equivalent to the individual department manager's.

Our survey separately measures three instruments that are often bundled together in discussions of managerial control: monitoring hours and supervisory hours from superiors, and the share of variable pay in the focal (subordinate) department manager's total compensation. Table 1 reports the variable definitions, and Table 2 reports the summary statistics.

We summarize the main variables as follows. Tables 1 and 2 show their descriptions and summary statistics, respectively.

□ Agent (subordinate) effort. The mean of the number of hours engaged in daily operations

across the five selling tasks: pricing, merchandising, product, personal selling, and sales planning. This variable captures how much effort the department manager devotes to the relevant tasks.

- ☐ Superior's monitoring effort. The number of hours the superiors spend on checking the subordinate's effort, behavior, and performance of work (e.g., verifying attainment of pre-agreed, expected effort, timeline, or goals).

- ☐ Superior's supervisory effort. The number of hours the superiors spend on enhancing productivity (e.g., providing guidance on how to manage things and people better; offering new knowledge to boost department performance.

- ☐ Superior's effort. It is the total time that each department manager interacting and communicating with the superior.

- ☐ Variable pay. This measures the proportion of the focal department manager's pay not coming from the base, fixed pay. The variable pay includes discretionary and achievement bonuses, cash awards, commissions, and other incentive pay.

In addition to manager effort as modeled in the theory, we study two other sales outcomes. First, sales-to-target performance, defined as realized sales relative to the sales target. This outcome is useful because it normalizes sales by the firm's own expectation for the department. Second, sales volume is measured as average sales from October 2021 to September 2022. Sales volume is not normalized as the sales-to-budget measure but provides a direct measure of realized sales revenue.

Control variables include the following ones.

- ☐ Local volatility. This measures the unpredictability of customer demand to the department.

- ☐ Experience. The average number of years of experience in the five selling tasks.

- ☐ Outside option. This measures the job market opportunity of the focal manager if he were terminated.

- ☐ Age, gender (male=1), and education (1-5 levels, from elementary school to college educated).

We describe the three instrumental variables for the three endogenous variables-variable pay, monitoring effort, and supervisory effort, respectively- below. Monitoring hours measure the superior's monitoring role. Supervisory hours measure a more productive form of

superiors' involvement, including guidance, support, and supervision. Incentive pay is the share of variable pay in total compensation. All three variables enter the regressions in logarithmic form, using $\log(x + 1)$.

- ☐ Peer's incentive pay, used to instrument variable pay. We divide the sales revenue of the focal manager's department into ten bins. We use the average variable pay of the focal manager's peers in the same bin as the instrument for variable pay.
- ☐ Weather monitoring, used to instrument the superior's monitoring effort. How much monitoring of weather forecasts and extreme weather alert and warning systems was implemented after a major weather shock in the last five years.
- ☐ Weather training, used to instrument the superior's supervisory effort. How much more training for employees in terms of awareness of and best practices under extreme weather events was conducted after a major weather shock in the last five years.

<insert table 1 about here>

<insert table 2 about here>

Two empirical issues are central. First, monitoring and supervision are related but conceptually distinct. Our calculation shows that the two variables are positively correlated. Regressions that include only one of them may partly absorb the effect of the other. This is why the key specifications include both monitoring and supervision, as well as their separate interactions with incentive pay. Second, all three instruments are potentially endogenous. Superiors may spend more time with departments that are difficult, promising, or already performing well. Likewise, the share of variable pay may reflect compensation policies targeted to particular types of departments or managers. We therefore report both OLS estimates and a control-function approach using the instrumental variables above.

The control-function approach uses separate first-stage equations for the three endogenous variables. Incentive pay is instrumented by peer incentive pay within revenue-decile and department-rank cells. This peer measure is intended to capture variation in compensation norms among comparable positions, rather than the focal department's own performance. Monitoring hours are instrumented using a weather-aptitude measure, and supervisory hours are instrumented using a weather-training measure. The identifying assumption is that these instruments affect outcomes only through incentive pay, monitoring hours, and supervisory hours, conditional on controls and store fixed effects. Standard errors are calculated using a bootstrap procedure that re-estimates both stages in each replication, thereby accounting

for the estimation uncertainty carried from the first-stage regressions into the second-stage regressions. Note that these estimates should be interpreted under the maintained exclusion restrictions, not as unconditional causal effects.

6 Empirical Analysis

6.1 Descriptive Pattern

Figure 1 plots the binned relationship between incentive pay and log manager effort. The left panel splits the sample by high versus low supervisory effort; the right panel uses the same split for monitoring effort. In both panels, the high-involvement curve tends to lie above the low-involvement curve across much of the incentive-pay distribution. This pattern is consistent with the basic idea that superior involvement is associated with higher subordinate managers' effort.

<insert figure 1 about here>

The figure is useful mainly as a descriptive diagnostic. It does not, by itself, establish interdependence. The vertical separation between high- and low-involvement groups is clearer than the difference in slopes. In particular, the high-supervision and high-monitoring curves are not uniformly steeper with respect to incentive pay. The figure therefore suggests that superior involvement matters for effort levels, but the complementarity or substitutability between involvement and pay must be assessed through the interaction regressions.

6.2 OLS (Correlational) Evidence

To illustrate the importance of disentangling superior effort, our analysis compares (i) the effect of the total number of hours superiors interact with and communicate with the focal subordinate department manager and (ii) the separated effect of monitoring and supervisory effort in both our OLS and instrumented regressions.

Table 3 presents the OLS results using the total number of hours a department manager's superiors interact with and communicate with him in a typical day. The main effect of (total) superior effort does not have a consistent sign across agent effort in column (1) and the two sales outcomes in columns (2) and (3). The more precise estimate in column (1) shows agent effort increases with (total) superior effort. Incentive pay's sign is also inconsistent across columns, with the more precise estimate for sales revenue being positive. Importantly, all the interaction terms in the three columns are minute and statistically not significant.

Tables 4 presents the OLS results with superior effort being separated into monitoring effort and supervisory effort. The outcomes of sales-to-target and sales performance are similarly shown in the next Table 5.

Table 4 reports OLS regressions for agent (the department manager's) effort. Columns (1) and (2) correspond to the main-effects and interaction specifications, respectively. In column (1), both superior effort measures are positively associated with manager effort. The coefficient on monitoring hours is 0.115, with a t-statistic of 5.309. The coefficient on supervisory hours is 0.072, with a t-statistic of 3.241. Incentive pay is also positively associated with effort, with a coefficient of 0.011 and a t-statistic of 2.479. Since the regression is specified in a log-log form, these coefficients are interpreted as elasticities of manager effort. They are consistent with the model's basic comparative statics: monitoring, supervision, and incentive pay are each associated with higher subordinate effort when considered as separate effort-inducing instruments. Monitoring effort shows the largest marginal effect among the three instruments.

<insert table 4 about here>

Column (2) adds the interaction terms of (i) monitoring effort and incentive pay and (ii) supervisory effort and incentive pay in the second column. The coefficient on monitoring becomes larger, 0.172, while the monitoring-pay interaction is negative, -0.020, though imprecisely estimated. The coefficient on supervision becomes small, 0.017, while the supervision-pay interaction is positive, 0.019, also imprecisely estimated. The effort regressions, therefore, point in the same direction as the theory but do not provide strong evidence on the interaction margins.

Regarding control variables, as expected, demand unpredictability negatively relates to manager effort, while more experience correlates with a higher level of manager effort. More educated managers spend less effort; possibly, they work smarter. Finally, manager effort increases with more outside job opportunities, probably because stronger outside option also signals stronger capability.

Table 5 turns to using sales outcomes as the dependent variable. Columns (1) and (2) use sales-to-budget performance; columns (3) and (4) use sales volume. The main-effects specifications show that incentive pay is positively associated with sales outcomes. In column (1), the coefficient on incentive pay in the sales-to-budget regression is 0.005, with a t-statistic of 1.761. In column (3), the coefficient in the sales regression is 0.048, with a t-statistic of 3.864. Monitoring is positively related to sales volume in column (3), with a coefficient of 0.105 and a t-statistic of 2.121, but it is not related to sales-to-budget performance in column (1). Supervisory hours are not statistically significant in the main-effects sales specifications.

<insert table 5 about here>

The interaction specifications in columns (2) and (4) provide the clearer OLS pattern. In the sales-to-budget regression, the interaction between monitoring and incentive pay is negative and precisely estimated: -0.013, with a t-statistic of -3.201. The interaction between supervisory effort and incentive pay is positive: 0.010, with a t-statistic of 2.441. The same signs appear in the sales-volume regression. The monitoring-pay interaction is -0.070, with a t-statistic of -1.997, while the supervision-pay interaction is 0.071, with a t-statistic of 1.834. Thus, in the OLS sales regressions, monitoring and incentive pay behave as substitutes, while supervisory involvement and incentive pay behave as complements.

Recall that the sign of the cross derivatives between monitoring and incentive pay is contingent on the intensity of incentive pay. According to National Tax Agency (2024), Japanese firms offered an average performance pay of 14.3% for wholesale and retailer workers. The department managers in our sample reported an average of about 30% (mean = 33% and median = 30%), more than double the national average. As such, we would expect the interaction term to be negative. The incentive intensity of our managers is in line with a recent survey on sales professionals, with 36.6% if a performance-related compensation system is implemented, but it is much higher than the 15.3% for those who work for companies not use such compensation systems (Xactly, 2022).

This asymmetry between the interaction effects of monitoring and supervision with incentive pay is the first central empirical result. It would be obscured if monitoring and supervision were combined into a single measure of superior effort. The sign of the interaction with pay depends on the nature of the superior's effort. Monitoring time is associated with a lower marginal effect of incentive pay on performance. Supervisory time, by contrast, is associated with a higher marginal effect of incentive pay. The result is consistent with the model's distinction between effort detection and productive involvement by superiors.

Although OLS regressions merely provide evidence in correlations, we have already seen significant differences between the estimates when superior effort is and is not separated into monitoring and supervisory efforts.

6.3 Control-Function First Stage

The OLS estimates are informative, but they are correlational. Superior effort and incentive pay may be jointly determined with expected performance. For example, a superior may monitor a department more intensively because the department manager is a recent hire, or may devote more supervisory time to a department with greater upside. Similarly, incentive pay may be higher in departments where variable compensation is expected to be especially

effective. We adopt the control-function approach for identification. Table 6 reports the regressions used in the control-function approach, with columns (1), (2), and (3) corresponding to the first-stage results on incentive pay, monitoring, and supervision, respectively.

<insert table 6 about here>

The instruments are strongly related to their corresponding endogenous variables. In column (1), peer incentive pay within revenue-decile and department-rank cells predicts the focal manager's incentive pay with a coefficient of 0.593 and a t-statistic of 5.005. In column (2), the weather-aptitude measure predicts monitoring hours with a coefficient of 0.111 and a t-statistic of 4.809. In column (3), the weather-training measure predicts supervisory hours with a coefficient of 0.099 and a t-statistic of 4.367. These first-stage results support instrument relevance.

The controls also behave in informative ways. Local volatility is negatively associated with both monitoring and supervision in the first stage, with coefficients of -0.022 and -0.018, respectively. Coordination importance is positively associated with both monitoring and supervision. This is plausible: departments in which coordination is more important may require more attention from superiors. Experience is positively associated with more fixed pay and weakly related to the superior-effort measures. The first-stage adjusted R^2 values are modest, which is common in this type of within-firm setting, but the excluded instruments are strong enough to support the control-function approach.

As with OLS regressions, we first share the results of superior effort without splitting it into monitoring and supervision. Table 7 shows that the interaction terms between (total) superior effort and incentive pay across the three regressions are tiny and statistically non-significant. The main effect of (total) superior effort is positively signed, but the estimates are particularly imprecise for the two sales outcomes.

We separate superior effort in our next analysis. First, we show the regressions in which only the main effects of the superior's monitoring and supervision.

6.4 Control-Function Main Effects

Table 8 reports the second-stage control-function estimates with main effects only. The columns are ordered so that manager effort appears first, followed by sales-to-budget performance and sales volume. The effort regression shows a strong positive association between monitoring and manager effort after endogeneity correction. The coefficient on monitoring is 0.969, with a t-statistic of 2.241. Supervisory hours also enter positively, with a coefficient of

0.623 and a t-statistic of 1.333. These estimates are larger than their OLS counterparts, suggesting that simple OLS may understate the association between superior involvement and subordinate effort. The coefficient of incentive pay is tiny and statistically not significant.

<insert table 8 about here>

The residual terms are informative. In the effort regression, the residual from the monitoring first stage is negative and significant, -0.862, with a t-statistic of -1.996, and the residual from the supervision first stage is also negative, -0.556, with a t-statistic of -1.195. These residual patterns indicate that the endogenous component of superior effort differs from the instrumented component. One interpretation is that superiors devote more effort to departments with unobserved difficulties, which attenuates the raw OLS relationship between superior effort and subordinate effort.

The sales regressions in Table 8 show that incentive pay is strongly positively associated with both sales-to-budget performance and sales volume. The coefficient is 0.064 in the sales-to-budget regression and 0.922 in the sales regression. The estimates of monitoring and supervision are positive and negative, respectively, but both are imprecisely estimated in the sales regressions. Local volatility remains negatively associated with sales outcomes, especially sales volume. This is consistent with the interpretation that volatile local conditions make sales performance more difficult even after accounting for superior effort, incentive pay, and controls.

Together, we find that monitoring, and to some extent, superior effort, motivates manager effort, whereas incentive pay elevates sales performance. In the following, we move on to examine the interaction effects.

Next, we add interaction terms in steps and then simultaneously.

6.5 Interaction Evidence in the Control-Function Specifications

Tables 9–11 show the interaction between superior effort and incentive pay in the control-function framework. Table 9 includes monitoring effort and its interaction with incentive pay, omitting the supervision channel. Monitoring has a large positive coefficient in the effort regression: 1.471, with a t-statistic of 3.347. It also has positive estimates in the two sales outcomes regressions, but they have large standard errors. The monitoring-pay interaction is negative in all three columns. Recall that this is expected when incentive pay has large values, which is indeed in our samples as we previously discussed. It is small and imprecise in the effort regression, but it is negative and more significant in the sales-to-budget regression: -0.007, with a t-statistic of -1.729. In the sales regression, the interaction is -0.027 and imprecisely estimated.

<insert table 9 about here>

Table 10 includes supervisory effort and its interaction with incentive pay, omitting monitoring. Supervisory effort has a large positive coefficient in the effort regression: 1.507, with a t-statistic of 1.570. Although the supervision-pay interaction is positive across all three columns, it is imprecise in the regressions. These results indicate that when monitoring is omitted, the productive-supervision channel may not cleanly be separated from the broader involvement of the superior.

<insert table 10 about here>

Table 11 is the central specification because it includes both monitoring and supervision simultaneously. This is important given the positive correlation between the two superior-effort measures. In the effort regression, monitoring and supervision remain positively associated with manager effort. The coefficient on monitoring is 1.033, with a t-statistic of 2.371. The coefficient on supervision is 0.565, with a t-statistic of 1.202. These main effects support our theoretical predictions.

The interaction terms in the effort regression have the predicted signs but are imprecisely estimated: the monitoring-pay interaction is -0.021, and the supervision-pay interaction is 0.022.

<insert table 11 about here>

The sales outcomes provide the strongest evidence. In the sales-to-budget regression, the monitoring-pay interaction is -0.013, with a t-statistic of -2.770, while the supervision-pay interaction is 0.010, with a t-statistic of 2.284. In the sales regression, the monitoring-pay interaction is -0.070, with a t-statistic of -1.901, while the supervision-pay interaction is 0.070, with a t-statistic of 1.739. These estimates closely mirror the OLS interaction evidence in Table 5. These results show that the negative monitoring–incentive pay interaction and the positive supervision–incentive pay interaction remain when both forms of superior effort are included in the same regression.

The comparison across Tables 9, 10, and 11 is also informative. When monitoring is included alone, the monitoring-pay interaction remains negative, but precision is concentrated in the sales-to-budget outcome. When supervision is included alone, the supervision-pay interaction is weak. When both are included, the two signs separate in the way predicted by the model: monitor substitutes but supervision complements incentive pay in producing sales performance. This pattern is consistent with the idea that monitoring and supervision are empirically correlated but economically distinct. The data need both variables in the same regression to reveal their different interaction effects with compensation. The interaction terms in the agent effort regression are weaker but directionally consistent.

6.6 Interpretation

Taken together, the estimates support the paper's main contribution: distinguishing superior effort between monitoring and supervision. Monitoring and incentive pay are not simply two independent ways to increase effort. In the sales regressions, they appear as substitutes for one another. When monitoring is high, the marginal association between incentive pay and sales performance is lower. This is consistent with the monitoring logic when incentive pay is already at a higher level: detection makes it less necessary to rely on the compensation premium to discipline effort, and a higher agent share can also weaken the principal's subsequent incentive to respond with supervision.

Supervisory effort behaves differently. In the sales regressions, supervisory effort and incentive pay tend to complement each other. When the superior's time is productive, that is, when it provides guidance, coaching, or support that raises the return to subordinate effort, formal incentive pay becomes more effective. This is consistent with the model's prediction when supervision and subordinate effort are technological complements.

We find qualitatively similar results when using agent effort as the outcome variable, although the estimates are slightly weaker. However, sales-to-budget and sales volume are more downstream outcomes because they aggregate the consequences of effort, supervision, monitoring, and local conditions. The fact that the interaction pattern appears strongly in both sales outcomes is reassuring.

Several caveats remain. First, the control-function estimates rely on the exclusion restrictions for peer incentive pay and the weather-based instruments. Rigorous field experiments would establish clean causal relationships. Second, the monitoring and supervision measures in our survey are proxies for different activities that may overlap in practice. Third, the signs of the interaction effects do not imply that firms should mechanically reduce one instrument whenever the other rises. They show how the marginal effects are related in this setting. The managerial implication is more subtle: firms should decide whether superior time is being used mainly to detect behavior or to improve the production environment. The same hour of superior attention can have different implications for the optimal use of incentive pay.

7 Conclusion

This paper separates two roles of superior effort. Monitoring increases the likelihood that subordinate effort is observed. Supervisory effort enhances a productive environment in which subordinate effort is supplied. This distinction matters in theory and practice. The same superior's time can substitute for incentive pay when it performs a monitoring function,

but complement incentive pay when it raises the marginal return to subordinate effort.

The model and evidence together suggest judicious choice of organizational attention spent by superiors. Firms should not ask only whether managers should spend more time with subordinates. They should ask what kind of time is being spent. Monitoring and coaching are different instruments used with incentive pay. Treating them as a single measure of managerial involvement can hide the economic forces that determine whether pay and effort reinforce one another or crowd each other out.

References

Aghion, Philippe, and Jean Tirole. 1997. "Formal and Real Authority in Organizations." *Journal of Political Economy* 105(1): 1–29.

Allgulin, Magnus, and Tore Ellingsen. 2002. "Monitoring and Pay." *Journal of Labor Economics* 20(2): 201–216.

Baker, George, Robert Gibbons, and Kevin J. Murphy. 2002. "Relational Contracts and the Theory of the Firm." *Quarterly Journal of Economics* 117(1): 39–84.

Baker, George, Robert Gibbons, and Kevin J. Murphy. 2023. "From Incentives to Control to Adaptation: Exploring Interactions between Formal and Relational Governance." SSRN working paper.

Bandiera, Oriana, Iwan Barankay, and Imran Rasul. 2007. "Incentives for Managers and Inequality among Workers: Evidence from a Firm-Level Experiment." *Quarterly Journal of Economics* 122(2): 729–773.

Beattie, Bruce R., and C. Robert Taylor. 1985. *The Economics of Production.* New York: Wiley.

Becker, Gary S., and George J. Stigler. 1974. "Law Enforcement, Malfeasance, and Compensation of Enforcers." *Journal of Legal Studies* 3(1): 1–18.

Cullen, Zoë, and Ricardo Perez-Truglia. 2022. "How Much Does Your Boss Make? The Effects of Salary Comparisons." *Journal of Political Economy* 130(3): 766–822.

Friebel, Guido, Matthias Heinz, Miriam Krueger, and Nikolay Zubanov. 2017. "Team Incentives and Performance: Evidence from a Retail Chain." *American Economic Review* 107(8): 2168–2203.

Hoffman, Mitchell, and Steven Tadelis. 2021. "People Management Skills, Employee Attrition, and Manager Rewards: An Empirical Analysis." *Journal of Political Economy* 129(1): 243–285.

Holmstrom, Bengt. 1979. "Moral Hazard and Observability." *Bell Journal of Economics* 10(1): 74–91.

Lazear, Edward P., and Paul Oyer. 2012. "Personnel Economics." In Robert Gibbons and John Roberts, eds., *The Handbook of Organizational Economics*. Princeton, NJ: Princeton University Press.

Lazear, Edward P., Kathryn L. Shaw, and Christopher T. Stanton. 2015. "The Value of Bosses." *Journal of Labor Economics* 33(4): 823–861.

Macchiavello, Rocco. 2022. "Relational Contracts and Development." *Annual Review of Economics* 14: 337–362.

Macchiavello, Rocco, and Ameet Morjaria. 2015. "The Value of Relationships: Evidence from a Supply Shock to Kenyan Rose Exports." *American Economic Review* 105(9): 2911–2945.

Macchiavello, Rocco, and Ameet Morjaria. 2023. "Relational Contracts: Recent Empirical Advancements and Open Questions." *Journal of Institutional and Theoretical Economics* 179(3–4): 673–700.

Roberts, John. 2004. *The Modern Firm*. New York: Oxford University Press.

Sandvik, Jason, Richard Saouma, Nathan Seegert, and Christopher T. Stanton. 2020. "Workplace Knowledge Flows." *Quarterly Journal of Economics* 135(3): 1635–1680.

Sandvik, Jason, Richard Saouma, Nathan Seegert, and Christopher T. Stanton. 2021. "Employee Responses to Compensation Changes: Evidence from a Sales Firm." *Management Science* 67(12): 7687–7707.

Shapiro, Carl, and Joseph E. Stiglitz. 1984. "Equilibrium Unemployment as a Worker Discipline Device." *American Economic Review* 74(3): 433–444.

Tirole, Jean. 1988. *The Theory of Industrial Organization*. Cambridge, MA: MIT Press.

National Tax Agency, Japan. 2024. "Statistical Survey of Actual Status of Private Sector Wages." Government statistical report.

Xactly Corporation. 2022. "Sales Incentive Survey 2022." Industry report.

United Nations Conference on Trade and Development (UNCTAD). 2024. "Business E-Commerce Sales and the Role of Online Platforms." UNCTAD Technical Notes on ICT for Development, No. 1. Geneva: United Nations.

Ministry of Economy, Trade and Industry (METI), Japan. 2025. "Results of FY2024 E-Commerce Market Survey Compiled." Press release, August 26. https://www.meti.go.jp/english/press/2025/0826_003.html

Tables and Figures

Table 1: Variable Definitions

Variable	Definition
effort_ave	Time effort, hours spent on a typical day at the store on merchandise, product, sales planning, personal selling, and pricing
coord_imp27	Coordination importance
incpay57	Share of variable pay
incpay57_peer_rbin	Share of variable pay for peer managers within revenue decile, across managers from same departments
superv_com243	Supervising hours from boss
monit_com244	Monitoring hours from boss
loc_vo111	Local volatility
wea_apt455	Weather shock on monitoring effort
wea_apt456	Weather shock on training effort
age51	Age
gender52	Gender
edu55	Education level
exp22_ave	Average experience over all tasks
payst282	The importance of incentive compensation to long-term performance of department

Table 2: Summary Statistics

	count	mean	std	min	25%	50%	75%	max
Sales_num_2110*	2871.000	—	—	—	—	—	—	—
Sales_Budget_num_2110*	2871.000	—	—	—	—	—	—	—
effort_ave	2871.000	1.432	0.872	0.000	0.800	1.200	1.800	6.000
superv_com243	2871.000	1.035	0.994	0.000	0.500	1.000	1.000	8.000
monit_com244	2871.000	1.015	1.030	0.000	0.500	1.000	1.000	9.000
incpay57	2871.000	32.983	28.184	0.000	10.000	30.000	50.000	99.000
incpay57_peer_rbin	2871.000	33.323	7.013	0.000	28.917	34.250	37.879	99.000
wea_apt455	2871.000	3.807	1.300	1.000	3.000	4.000	5.000	7.000
wea_train456	2871.000	3.793	1.310	1.000	3.000	4.000	5.000	7.000
payst282	2871.000	3.790	1.351	1.000	2.800	4.000	4.000	7.000
loc_vo111	2871.000	4.111	1.411	1.000	3.000	4.000	5.000	7.000
coord_imp27	2871.000	5.267	1.283	1.000	5.000	6.000	6.000	7.000
exp22_ave	2871.000	7.991	5.826	0.000	3.467	6.667	11.333	39.417
edu55	2871.000	3.427	0.863	1.000	3.000	4.000	4.000	5.000
gender52	2871.000	0.728	0.445	0.000	0.000	1.000	1.000	1.000
OutOpt5121	2871.000	3.581	1.502	1.000	2.000	4.000	5.000	7.000
sub_com261	2871.000	12.895	17.787	0.000	5.000	10.000	15.000	452.000

Notes. Summary statistics for the estimation sample (N = 2,871). *Values are hidden for confidentiality purposes.

Table 3: Total Effects: log(Vertical Communication) and Incentive Pay (OLS Interaction)

	(1) log effort	(2) log sales-to-budget	(3) log sales
Intercept	0.738***	4.566***	9.240***
	(8.289)	(104.899)	(32.320)
log(verti_com242 + 1)	0.090**	-0.026	0.088
	(2.430)	(-1.269)	(0.859)
log(incpay57 + 1)	0.005	-0.001	0.044*
	(0.440)	(-0.197)	(1.654)
log(verti + 1) × log(incpay57 + 1)	0.008	0.007	0.005
	(0.646)	(1.297)	(0.164)
loc_vo111	-0.012***	-0.012***	-0.098***
	(-2.724)	(-4.400)	(-8.287)
coord_imp27	-0.003	-0.001	-0.052***
	(-0.542)	(-0.298)	(-4.270)
exp22_ave	0.010***	-0.001***	-0.009***
	(9.810)	(-2.704)	(-3.393)
edu55	-0.018**	0.000	0.044**
	(-2.389)	(0.108)	(2.335)
risk511	0.007*	0.001	0.008
	(1.920)	(1.024)	(0.874)
gender52	0.031**	0.018***	0.520***
	(2.165)	(3.797)	(14.827)
OutOpt5121	0.010**	0.004**	0.025**
	(2.465)	(2.062)	(2.367)
log(sub_com261 + 1)	-0.032***	0.003	0.264***
	(-3.496)	(0.637)	(10.466)
Observations	2,871	2,871	2,871
Adjusted R^2	0.087	0.164	0.224

Notes: t-statistics in parentheses. Standard errors are clustered at the store-department level. All specifications include store fixed effects and control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Effect of Manager Effort and Compensation on Work Effort

	(1) log effort, main	(2) log effort, interaction
Intercept	0.691***	0.691***
	(7.957)	(7.698)
log(monit_com244 + 1)	0.115***	0.172***
	(5.309)	(3.840)
log(superv_com243 + 1)	0.072***	0.017
	(3.241)	(0.367)
log(incpay57 + 1)	0.011**	0.011
	(2.479)	(1.245)
log(monit + 1) × log(incpay57 + 1)	–	-0.020
		(-1.388)
log(superv + 1) × log(incpay57 + 1)	–	0.019
		(1.312)
loc_vo111	-0.010**	-0.010**
	(-2.295)	(-2.318)
coord_imp27	-0.005	-0.005
	(-0.979)	(-0.995)
exp22_ave	0.010***	0.010***
	(9.777)	(9.762)
edu55	-0.015**	-0.015**
	(-1.994)	(-2.033)
risk511	0.006	0.006
	(1.593)	(1.571)
gender52	0.022	0.022
	(1.561)	(1.561)
OutOpt5121	0.013***	0.013***
	(3.024)	(2.998)
log(sub_com261 + 1)	-0.030***	-0.030***
	(-3.420)	(-3.367)
Observations	2,871	2,871
Adjusted R^2	0.087	0.087

Notes: t-statistics in parentheses. Standard errors are clustered at the store-department level. All specifications include store fixed effects and control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Effect of Manager Effort and Compensation on Sales

	(1) budget, main	(2) budget, interaction	(3) sales, main	(4) sales, interaction
Intercept	4.549***	4.545***	9.244***	9.255***
	(133.246)	(135.332)	(33.584)	(33.222)
log(monit_com244 + 1)	-0.002	0.035***	0.105**	0.309***
	(-0.404)	(2.712)	(2.121)	(2.724)
log(superv_com243 + 1)	-0.003	-0.032**	0.006	-0.205
	(-0.458)	(-2.322)	(0.102)	(-1.577)
log(incpay57 + 1)	0.005*	0.007*	0.048***	0.046*
	(1.761)	(1.860)	(3.864)	(1.940)
log(monit + 1) × log(incpay57 + 1)	–	-0.013***	–	-0.070**
		(-3.201)		(-1.997)
log(superv + 1) × log(incpay57 + 1)	–	0.010**	–	0.071*
		(2.441)		(1.834)
loc_vo111	-0.012***	-0.012***	-0.097***	-0.097***
	(-4.437)	(-4.456)	(-8.245)	(-8.301)
coord_imp27	-0.001	-0.001	-0.052***	-0.052***
	(-0.276)	(-0.294)	(-4.253)	(-4.287)
exp22_ave	-0.001***	-0.001***	-0.009***	-0.009***
	(-2.704)	(-2.718)	(-3.434)	(-3.456)
edu55	0.000	0.000	0.046**	0.045**
	(0.079)	(0.036)	(2.430)	(2.380)
risk511	0.001	0.001	0.007	0.007
	(1.106)	(1.072)	(0.773)	(0.742)
gender52	0.018***	0.018***	0.514***	0.514***
	(3.831)	(3.838)	(14.656)	(14.671)
OutOpt5121	0.004**	0.003**	0.026**	0.026**
	(2.083)	(2.056)	(2.520)	(2.493)
log(sub_com261 + 1)	0.003	0.003	0.265***	0.267***
	(0.633)	(0.675)	(10.932)	(11.006)
Observations	2,871	2,871	2,871	2,871
Adjusted R^2	0.163	0.164	0.225	0.226

Notes: t-statistics in parentheses. Standard errors are clustered at the store-department level. All specifications include store fixed effects and control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

This table is retained as in the June 4 memo. The interpretation should be clarified before circulation, especially because the two sales outcomes capture different objects and OLS interactions may combine causal effects with selection.

Table 6: First Stage of the Control-Function Approach

	(1) log(incpay57 + 1)	(2) log(monit_com244 + 1)	(3) log(superv_com243 + 1)
Intercept	1.121**	0.400***	0.594***
	(2.052)	(2.756)	(4.072)
log(incpay57_peer_rbin + 1)	0.593***	–	–
	(5.005)		
log(wea_apt455 + 1)	–	0.111***	–
		(4.809)	
log(wea_train456 + 1)	–	–	0.099***
			(4.367)
payst282	-0.007	–	–
	(-0.333)		
loc_vo111	0.005	-0.022***	-0.018***
	(0.294)	(-4.377)	(-3.567)
coord_imp27	0.003	0.023***	0.028***
	(0.152)	(3.855)	(4.902)
exp22_ave	-0.027***	0.000	0.002*
	(-5.438)	(0.177)	(1.751)
edu55	-0.010	-0.023***	-0.017**
	(-0.288)	(-2.609)	(-1.985)
risk511	0.013	0.004	0.003
	(0.804)	(1.041)	(0.776)
gender52	-0.044	0.060***	0.038**
	(-0.690)	(3.651)	(2.486)
OutOpt5121	0.043**	-0.014***	-0.009*
	(2.355)	(-2.796)	(-1.917)
log(sub_com261 + 1)	0.019	0.004	-0.001
	(0.508)	(0.433)	(-0.151)
Observations	2,871	2,871	2,871
Adjusted R^2	0.006	0.033	0.045

Notes: t-statistics in parentheses. Standard errors are clustered at the store-department level. All specifications include store fixed effects and control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Total Effects: log(Vertical Communication) and Incentive Pay (Control Function, Bootstrap SE)

	(1) log effort	(2) log sales-to-budget	(3) log sales
Intercept	-1.009	4.344***	6.452***
	(-0.717)	(21.944)	(5.833)
log(verti_com242 + 1)	2.526	0.017	0.076
	(1.527)	(0.082)	(0.077)
log(incpay57 + 1)	-0.015	0.059**	0.915***
	(-0.314)	(2.137)	(3.994)
log(verti + 1) × log(incpay57 + 1)	0.007	0.007	0.004
	(0.530)	(1.138)	(0.111)
loc_vo111	0.029	-0.011**	-0.098***
	(0.974)	(-2.435)	(-3.657)
coord_imp27	-0.061	-0.002	-0.053
	(-1.578)	(-0.350)	(-1.513)
exp22_ave	0.008*	0.000	0.015*
	(1.702)	(0.210)	(1.743)
edu55	-0.003	0.001	0.048
	(-0.072)	(0.159)	(1.172)
risk511	0.016	0.001	-0.005
	(1.233)	(0.271)	(-0.226)
gender52	0.017	0.021***	0.568***
	(0.377)	(2.791)	(7.749)
OutOpt5121	0.007	0.001	-0.013
	(0.522)	(0.304)	(-0.559)
log(sub_com261 + 1)	-0.061*	0.001	0.238***
	(-1.674)	(0.150)	(4.988)
res_inc	0.020	-0.060**	-0.878***
	(0.470)	(-2.178)	(-3.810)
res_verti	-2.443	-0.022	0.029
	(-1.462)	(-0.102)	(0.028)
Observations	2,871	2,871	2,871
Adjusted R^2	0.096	0.165	0.240

Notes: t-statistics in parentheses. Standard errors are bootstrapped (B=1000). *p<0.10, **p<0.05, ***p<0.01. All specifications include store fixed effects and control variables.

Table 8: Second Stage of Control-Function Approach: Main Effects

	(1) log effort	(2) log sales-to-budget	(3) log sales
Intercept	-0.101	4.371***	6.549***
	(-0.243)	(35.693)	(6.886)
log(monit_com244 + 1)	0.969**	0.097	0.259
	(2.241)	(0.516)	(0.274)
log(superv_com243 + 1)	0.623	-0.095	-0.268
	(1.333)	(-0.434)	(-0.242)
log(incpay57 + 1)	-0.007	0.064**	0.922***
	(-0.153)	(2.391)	(4.035)
loc_vo111	0.019	-0.011***	-0.099***
	(1.422)	(-2.889)	(-3.859)
coord_imp27	-0.041***	-0.001	-0.049
	(-2.581)	(-0.103)	(-1.522)
exp22_ave	0.007**	0.000	0.016*
	(2.430)	(0.377)	(1.751)
edu55	0.014	0.001	0.049
	(0.736)	(0.216)	(1.138)
risk511	-0.001	0.000	-0.005
	(-0.093)	(0.151)	(-0.258)
gender52	-0.049	0.019*	0.563***
	(-1.326)	(1.813)	(6.974)
OutOpt5121	0.028***	0.001	-0.012
	(2.722)	(0.505)	(-0.503)
log(sub_com261 + 1)	-0.030	0.001	0.237***
	(-1.632)	(0.130)	(5.018)
res_inc	0.017	-0.060**	-0.882***
	(0.369)	(-2.190)	(-3.844)
res_moni	-0.862**	-0.099	-0.143
	(-1.996)	(-0.527)	(-0.151)
res_sup	-0.556	0.091	0.262
	(-1.195)	(0.411)	(0.237)
Observations	2,871	2,871	2,871
Adjusted R^2	0.104	0.165	0.240

Notes: t-statistics in parentheses. Standard errors are bootstrapped (B=1000). *p<0.10, **p<0.05, ***p<0.01. All specifications include store fixed effects and control variables.

Table 9: Second Stage: Monitoring Effort Only

	(1) log effort	(2) log sales-to-budget	(3) log sales
Intercept	0.066	4.329***	6.414***
	(0.165)	(39.283)	(7.344)
log(monit_com244 + 1)	1.471***	0.044	0.132
	(3.347)	(0.603)	(0.247)
log(monit + 1) × log(incpay57 + 1)	-0.007	-0.007*	-0.027
	(-0.628)	(-1.729)	(-0.917)
log(incpay57 + 1)	-0.000	0.069**	0.940***
	(-0.000)	(2.529)	(4.105)
loc_vo111	0.019	-0.011***	-0.099***
	(1.376)	(-3.026)	(-4.097)
coord_imp27	-0.034**	-0.001	-0.052*
	(-2.426)	(-0.418)	(-1.865)
exp22_ave	0.008***	0.000	0.015*
	(3.146)	(0.267)	(1.793)
edu55	0.015	0.001	0.048
	(0.770)	(0.197)	(1.153)
risk511	-0.001	0.000	-0.005
	(-0.101)	(0.165)	(-0.264)
gender52	-0.056	0.020**	0.566***
	(-1.385)	(2.346)	(7.274)
OutOpt5121	0.029***	0.001	-0.013
	(2.770)	(0.462)	(-0.532)
log(sub_com261 + 1)	-0.034*	0.001	0.238***
	(-1.865)	(0.208)	(5.177)
res_inc	0.015	-0.060**	-0.883***
	(0.314)	(-2.182)	(-3.856)
res_moni	-1.301***	-0.028	0.060
	(-2.972)	(-0.396)	(0.115)
Observations	2,871	2,871	2,871
Adjusted R^2	0.101	0.165	0.240

Notes: t-statistics in parentheses. Standard errors are bootstrapped (B=1000). *p<0.10, **p<0.05, ***p<0.01. All specifications include store fixed effects and control variables.

Table 10: Second Stage: Supervision Effort Only

	(1) log effort	(2) log sales-to-budget	(3) log sales
Intercept	-0.201	4.361***	6.560***
	(-0.345)	(39.303)	(7.377)
log(superv_com243 + 1)	1.507	-0.010	-0.062
	(1.570)	(-0.108)	(-0.101)
log(superv + 1) × log(incpay57 + 1)	0.007	0.001	0.022
	(0.583)	(0.343)	(0.664)
log(incpay57 + 1)	-0.016	0.064**	0.900***
	(-0.341)	(2.358)	(3.967)
loc_vo111	0.014	-0.012***	-0.100***
	(0.700)	(-3.853)	(-4.306)
coord_imp27	-0.044	-0.001	-0.051*
	(-1.559)	(-0.164)	(-1.665)
exp22_ave	0.005	0.000	0.015*
	(1.361)	(0.287)	(1.736)
edu55	0.007	0.001	0.047
	(0.311)	(0.101)	(1.143)
risk511	0.001	0.000	-0.005
	(0.088)	(0.241)	(-0.247)
gender52	-0.023	0.021***	0.568***
	(-0.650)	(2.721)	(7.591)
OutOpt5121	0.024**	0.001	-0.013
	(2.101)	(0.316)	(-0.554)
log(sub_com261 + 1)	-0.025	0.001	0.240***
	(-1.201)	(0.225)	(5.221)
res_inc	0.022	-0.060**	-0.875***
	(0.470)	(-2.195)	(-3.848)
res_sup	-1.386	0.001	0.072
	(-1.444)	(0.013)	(0.118)
Observations	2,871	2,871	2,871
Adjusted R^2	0.094	0.165	0.239

Notes: t-statistics in parentheses. Standard errors are bootstrapped (B=1000). *p<0.10, **p<0.05, ***p<0.01. All specifications include store fixed effects and control variables.

Table 11: Second Stage: Interacting Both Types of Managerial Effort

	(1) log effort	(2) log sales-to-budget	(3) log sales
Intercept	-0.103	4.363***	6.534***
	(-0.247)	(35.727)	(6.865)
log(monit_com244 + 1)	1.033**	0.134	0.467
	(2.371)	(0.707)	(0.488)
log(superv_com243 + 1)	0.565	-0.119	-0.446
	(1.202)	(-0.546)	(-0.402)
log(monit + 1) × log(incpay57 + 1)	-0.021	-0.013***	-0.070*
	(-1.364)	(-2.770)	(-1.901)
log(superv + 1) × log(incpay57 + 1)	0.022	0.010**	0.070*
	(1.440)	(2.284)	(1.739)
log(incpay57 + 1)	-0.008	0.066**	0.921***
	(-0.172)	(2.443)	(4.027)
loc_vo111	0.019	-0.011***	-0.099***
	(1.416)	(-2.887)	(-3.861)
coord_imp27	-0.041***	-0.001	-0.050
	(-2.583)	(-0.134)	(-1.558)
exp22_ave	0.007**	0.000	0.015*
	(2.407)	(0.367)	(1.744)
edu55	0.014	0.001	0.048
	(0.724)	(0.197)	(1.125)
risk511	-0.001	0.000	-0.006
	(-0.109)	(0.121)	(-0.278)
gender52	-0.049	0.019*	0.562***
	(-1.332)	(1.801)	(6.949)
OutOpt5121	0.028***	0.001	-0.012
	(2.708)	(0.496)	(-0.506)
log(sub_com261 + 1)	-0.030	0.001	0.239***
	(-1.594)	(0.163)	(5.046)
res_inc	0.017	-0.060**	-0.882***
	(0.368)	(-2.192)	(-3.859)
res_moni	-0.863**	-0.098	-0.145
	(-1.993)	(-0.525)	(-0.153)
res_sup	-0.566	0.086	0.234
	(-1.205)	(0.391)	(0.213)
Observations	2,871	2,871	2,871
Adjusted R^2	0.105	0.165	0.240

Notes: t-statistics in parentheses. Standard errors are bootstrapped (B=1000). *p<0.10, **p<0.05, ***p<0.01. All specifications include store fixed effects and control variables.

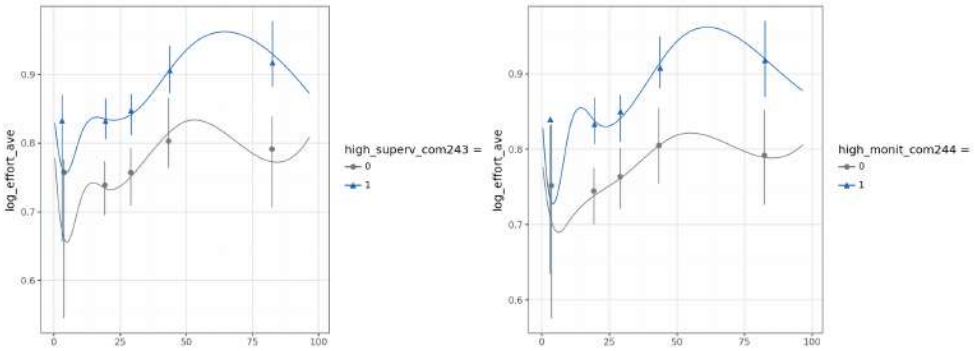


Figure 1: Binscatter Plots of Incentive Pay and Log Manager Effort