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Training Investment and the Choice of Wage Adjustment Instruments in Japanese Firms

HE Fang

This paper examines how firm-sponsored training is associated with Japanese firms' choice of wage adjustment instruments. This issue is important in Japan because firms may raise pay through different instruments, including regular increases, base-up adjustments, and bonus increases, which differ in permanence and institutional meaning. Using three waves of the JILPT Corporate Panel Survey covering the 2022–2024 *Shunto* rounds, I analyze two related dimensions of wage adjustment: whether firms grant any wage increase and, among wage-increasing firms, which adjustment instruments they use. Alongside the training indicators that are the main focus of the analysis, I examine firm-level digitalization as a secondary but substantively important dimension of wage-setting behavior. The results show that firms that invest more actively in employee training are more likely to grant wage increases. In addition, for several training indicators, the estimated associations are more consistently positive for base-up adjustments and bonus increases than for regular increases. The digitalization estimates are more mixed, but they suggest that the depth of digital technology use is related to how firms structure wage adjustments. These findings suggest that wage adjustment behavior in Japanese firms is associated not only with human capital investment but also with the technological environment in which wage-setting decisions are made.

I. Introduction

In recent years, wage increases have become an important issue in Japan amid rising prices, labor shortages, and growing policy interest in sustainable wage growth. The 2022–2024 *Shunto* (springtime labor-management wage negotiations) rounds saw wage settlements rise to levels not observed in roughly three decades, with base-up adjustments again becoming a visible component of these settlements. However, firms do not respond in a uniform way. Some grant regular increases, some revise the wage schedule itself, and others rely more heavily on bonuses. Understanding what shapes these different forms of wage adjustment is therefore important for interpreting current developments in the Japanese employment system. One possible factor is firm-sponsored training. If firms regard training as an investment in workforce capability, they may be more willing both to raise wages and to use particular wage adjustment instruments.

This paper examines how human capital investment is associated with two dimensions of wage adjustment in Japanese firms: the incidence of wage increases and the choice of wage adjustment instruments. Japan provides an informative setting because firms commonly combine regular increases, base-up adjustments, and bonus payments,[1] each of which differs in permanence and institutional meaning. This makes it possible to ask not only whether training-intensive firms raise wages, but also whether they channel the returns to training into fixed pay or more flexible compensation.

The paper makes two main contributions. First, it develops an empirical framework that treats wage adjustment in Japanese firms as a structured choice among regular increases, base-up adjustments, and

bonus increases—instruments that differ in permanence and institutional meaning—rather than as a single outcome. Second, the paper applies this framework to recent firm-level microdata and provides new evidence on how firm-sponsored training is associated with both the incidence and the composition of wage adjustment, an aspect of the training–wage relationship that has received limited empirical attention.

In addition, while training is the central explanatory dimension of the paper, the analysis considers whether firm-level digitalization is associated with the same wage-setting outcomes in separate specifications. By doing so, the paper connects the training literature to the industrial relations literature on wage-setting institutions and to the related literature on technological change in the workplace.

Using data from three waves of the JILPT Corporate Panel Survey, I estimate probit models for wage increase incidence and multivariate probit models for the joint choice of wage adjustment instruments among firms that granted a wage increase. This two-part design reflects the institutional structure of the decisions: firms first determine whether to raise wages at all and then, conditional on doing so, decide how to allocate the increase across instruments. In addition to the training indicators that are the main focus of the analysis, I also examine measures of firm-level digitalization, which capture differences in the technological environment of wage-setting decisions and allow me to assess whether similar patterns appear in specifications using digitalization variables. The results suggest that training investment is associated with both wage increase incidence and the composition of wage adjustment.

The remainder of the paper proceeds as follows. Section II reviews the related literature and identifies the research gap. Section III develops the hypotheses. Section IV describes the empirical strategy. Section V presents the main results. Section VI discusses the implications and limitations of the findings. Section VII concludes.

II. Related literature

The relationship between firm-sponsored training and wages has long been debated, but from an industrial relations perspective the key issue is not only whether training is associated with higher pay, but also how training-related gains are translated into wage-setting decisions. A central theoretical contribution is Acemoglu and Pischke (1999), who show that even general training may be financed by firms when labor markets are imperfect. Under conditions of wage compression, information asymmetries, and other forms of institutional rigidity, firms may capture part of the return to training because productivity gains are not fully translated into wages. This insight is important for the present study because it suggests that training investment and wage setting are not independent processes. Rather, the way firms share training-related gains with workers depends on the institutional environment in which wage determination takes place.

1. Training and wages: International and Japanese evidence

Empirical research has generally supported the idea that training is associated with higher wages and, in some settings, higher productivity, although the magnitude and form of these effects vary across firms and sectors. Using firm-level data from the United States, Bartel (1995) finds that formal training improves both wage growth and job performance even after accounting for selection. Black et al. (1999) show that establishment size and firm size shape the amount and composition of training, suggesting economies of scale in human capital production. Dearden et al. (2006) use British panel data to document positive effects of training on both productivity and wages.

For Japan, there is a long intellectual tradition linking on-the-job training (OJT) to skill formation and internal labor markets. Koike (2005) argues that the breadth of skills acquired through planned OJT, particularly through systematic job rotation, is a defining feature of the Japanese employment system, and that this pattern of skill formation underpins the

long-term employment relationship. Mincer and Higuchi (1988) formalize the link between firm-specific human capital, steeper age-wage profiles, and lower turnover in Japan than in the United States. These contributions frame the Japanese firm as an institution in which training and wage setting are tightly coupled through internal labor markets rather than through market-mediated wage competition.

More recent quantitative work has refined this picture. Owan (2004) develops and tests a model in which promotion, turnover, and firm-sponsored training are jointly determined, showing that training is not merely a productivity-enhancing input but also a central element of the firm's retention and career-management strategy. Kawaguchi (2006) documents the incidence and wage effects of OJT among Japanese women, highlighting substantial heterogeneity across worker groups. Morikawa (2021) reports that accumulated off-the-job training (Off-JT) raises both productivity and wages, especially in services, while Jones et al. (2012) show that training has a relatively robust positive association with wages even when its effects on firm performance are more limited. Kato and Owan (2011) go further and argue that training decisions are best understood as part of a broader human resource management "bundle," jointly determined with teamwork, shop-floor practices, and wage institutions. Taken together, these studies indicate that training is often linked to wage outcomes in Japan, but they leave open how such gains are translated into different forms of wage adjustment within firms.

2. Wage-setting institutions in Japan

A second strand of literature directly relevant to the present study concerns wage-setting institutions in Japan. Japanese firms do not simply decide whether to raise wages; they decide how to allocate any increase across instruments that carry different institutional meanings. The annual *Shunto* process, in which enterprise unions negotiate with management each spring on the basis of coordinated demands from industrial federations, shapes both whether firms raise pay and which instruments they use. Hara and Kawaguchi (2008) show that the coordinated nature of *Shunto* allows enterprise unions to obtain larger wage gains than would be expected from purely firm-level bargaining, thereby linking collective bargaining institutions to observed wage outcomes. Kato (2016) provides a comprehensive account of the interaction between *Shunto*, enterprise unionism, and the base-up/bonus split, arguing that bargaining over base-up has become relatively less central while bonus bargaining has taken a larger role, particularly since the 1990s.

This institutional background matters for understanding both downward and, in some respects, upward wage rigidity in Japan. Kawaguchi and Ohtake (2007) examine the morale theory of downward nominal wage rigidity and find evidence consistent with reference-point-based models among Japanese workers. Kuroda and Yamamoto (2014) document that nominal wage rigidity weakened substantially after the late 1990s, a period during which firms increasingly relied on bonus adjustments rather than base-up revisions to manage labor costs. Yamamoto and Kuroda (2016) provide direct firm-level evidence of upward rigidity: firms that had previously cut scheduled earnings were more reluctant to raise both scheduled earnings and bonuses even during the economic expansion of 2014–2015. Hoshi and Kashyap (2020, 2025) trace how these firm-level behaviors aggregated into a persistent decoupling of wages from labor market tightness, and how this pattern has only begun to normalize in the most recent *Shunto* rounds. Against this background, firms' choice among regular increases, base-up adjustments, and bonus increases is not a neutral selection among equivalent instruments, but a decision about how far to commit to a lasting revision of the wage schedule.

Macroeconomic and policy developments during this period are particularly relevant to the study of wage-setting instrument choice. The data used in this paper cover the 2022–2024 *Shunto* rounds, a period in which Japanese wage dynamics underwent a pronounced shift. After decades of modest wage growth dominated by bonus-centered adjustments rather than base-up revisions, *Shunto* settlements

rose from around 2% in 2022 to 3.58% in 2023 and to above 5% in 2024—the highest levels in roughly three decades—with base-up adjustments regaining a prominent role (Hoshi and Kashyap 2025). Contributing factors include sustained inflationary pressure, persistently tight labor markets, and continued government calls for wage increases, which built on the policy orientation that had developed over the preceding decade (Kawaguchi et al. 2021). In this context, the present paper studies firm-level wage adjustment during precisely the period in which the long-standing default of bonus-based adjustment was being reconsidered, making it possible to examine whether training-intensive firms were more likely than others to translate wage increases into permanent base-up revisions rather than into more flexible bonus payments.

3. The Japanese employment system and internal labor markets

A third literature, closely related to both strands, concerns the broader Japanese employment system within which training and wage adjustment take place. Kambayashi and Kato (2017), using long-horizon data on tenure and job stability, document that long-term employment among prime-age regular workers has remained remarkably resilient through the "Lost Decades," although the share of workers covered by this system has gradually narrowed. Hamaaki et al. (2012), by contrast, emphasize erosion of the seniority-wage component of the system, showing that age-wage profiles have flattened particularly in the mid- and late-career stages. Taken together, these studies suggest that the Japanese employment system has evolved into a more heterogeneous configuration in which long-term employment and seniority-based pay are no longer tightly bundled. This distinction matters for the present analysis because the extent to which firms translate training investment into fixed-pay adjustments, as opposed to flexible bonus adjustments, may depend on how strongly they continue to rely on internal-labor-market logic.

4. Research gap

Taken together, the literature suggests that training is often linked to wage outcomes in Japan, but it leaves open how firms distribute wage adjustments across instruments that differ in permanence and institutional meaning. The training literature treats wages largely as a single outcome; the wage-setting literature has studied the choice among instruments in detail but has paid relatively little attention to the role of human capital investment; and the employment-system literature has documented institutional change but has rarely connected it explicitly to firm-level training decisions. This paper addresses that gap by examining both whether firms grant wage increases and which wage adjustment instruments they use when they do so. Using the JILPT Corporate Panel Survey, the analysis connects the training literature to the industrial relations literature on wage-setting institutions. Rather than treating wage growth as a single outcome, the study recasts wage adjustment as a structured choice among instruments with different institutional meanings and cost implications.

III. Hypotheses

Building on the literature reviewed above, the hypotheses focus on two related questions: whether training-intensive firms are more likely to grant wage increases, and how they allocate wage adjustments across fixed-pay and more flexible instruments.

Hypothesis 1: Firms that invest more actively in employee training are more likely to grant wage increases.

The first expectation concerns the extensive margin of wage setting. If training investment enhances worker skills, improves expected productivity, or reflects a broader managerial commitment to workforce development, firms undertaking such investment should be more likely to implement wage increases in the following year. This expectation is also consistent with the view that training-intensive firms are more willing to retain the workers in whom they have invested by improving pay.

Hypothesis 2: Among firms that grant wage increases, training investment is positively associated with the use of base-up adjustments.

This hypothesis reflects the idea that training may be linked to a stronger willingness to translate workforce-related commitments into more durable revisions of the wage schedule. In the Japanese setting, base-up adjustments are institutionally distinct from regular increases because they raise the wage schedule itself rather than merely operating within existing progression rules.

Hypothesis 3: Among firms that grant wage increases, training investment is also positively associated with bonus increases, although this association is expected to be more contingent than that for base-up adjustments.

Bonus increases provide a more flexible channel of compensation than base-up adjustments. Accordingly, if firms seek to reward or retain workers while preserving flexibility under uncertain business conditions, training investment may also be associated with bonus-based adjustment. Relative to Hypothesis 2, however, the expected link is conceptually weaker because bonuses do not imply the same degree of lasting revision to the wage structure.

IV. Empirical strategy

This paper tests Hypotheses 1–3 by examining two dimensions of firm-level wage adjustment. First, I analyze whether a firm grants any wage increase in a given year. Second, conditional on granting a wage increase, I examine which wage adjustment instruments the firm uses. The analysis uses pooled firm-year observations from the first three waves of the JILPT Corporate Panel Survey,[2] which makes it possible to relate prior training investment to subsequent wage adjustment outcomes.

1. Data

The analysis uses firm-level microdata from the first three waves (2022–2024) of the JILPT Corporate Panel Survey, conducted annually by the Japan Institute for Labour Policy and Training (JILPT). The survey tracks the same firms over time, allowing observation of how firms' human resource development practices and wage adjustment behavior evolve from year to year.

The survey is administered in two parts, reflecting different sampling frames. The survey of small- and medium-sized firms draws from the monitor-firm pool of the survey contractor, while the large-firm survey draws from the contractor's corporate financial database. This paper uses the combined data from both surveys. To ensure consistent treatment of firm size across the two sampling frames, firms are reclassified according to the total number of employees reported in the survey itself, rather than by their sampling-frame origin. The resulting pooled data therefore provide firm-year observations with a harmonized firm-size classification.

2. Dependent variables

The first dependent variable is an indicator for whether the firm implemented any wage increase in year *t*. Following the survey questionnaire, this variable takes the value of one if the firm reported any wage increase and zero if it selected "no wage increase implemented." This measure captures wage increase incidence. The second set of dependent variables captures the choice of wage adjustment instruments among firms that granted a wage increase. I focus on three binary indicators: regular increases, base-up adjustments, and bonus increases. These three instruments are analytically important because they differ in permanence and cost implications. Regular increases largely follow existing pay progression rules, base-up adjustments raise the wage schedule itself, and bonus increases provide a more flexible channel of compensation. Firms that reported a wage increase but did not select any of these three instruments are excluded from the instrument-choice analysis, because they do not provide usable information on the composition of wage adjustment across the focal instruments. In the pooled data, this excluded group accounts for 166 firms, or 2.1 percent of wage-increasing firms.[3] The second-stage estimates should therefore be

interpreted as evidence on instrument choice conditional on wage increase incidence and reporting one or more of the three focal instruments.

3. Key explanatory variables

The empirical analysis uses two groups of lagged explanatory variables. The first group consists of indicators of firm-sponsored training, which are the main focus of the paper. These include (1) indicators for whether the firm implemented planned OJT or Off-JT in the previous year, (2) an indicator for any training expenditure and the log-transformed ratio of training expenditure to total cash earnings,[4] (3) the share of employees participating in training, and (4) annual training hours per participant. All training variables are measured with reference to the period preceding the wage adjustment outcome to establish temporal ordering between training investment and wage-setting decisions. Because these indicators capture overlapping aspects of human resource development, I include them one at a time in the estimation.

The second group consists of indicators of firm-level digitalization. Specifically, I include a dummy variable indicating whether the firm used digital technologies such as enterprise resource planning (ERP) systems or cloud-based information-sharing tools in the previous fiscal year, and a continuous variable measuring the number of digital technology items in use.[5] While these variables are not the main focus of the paper, they are included as a secondary but substantively important set of explanatory variables rather than as mere controls. They are intended to capture differences in firms' technological environment and organizational modernization that may also be associated with wage-setting behavior. The training indicators and digitalization indicators are entered separately across specifications.

The training expenditure dummy, the training expenditure ratio, the training participation rate, and annual training hours per participant are based on survey items that directly ask about the previous fiscal year, whereas the planned OJT/Off-JT indicators are drawn from the preceding wave of the survey. As a result, the estimation sample size varies across specifications.

4. Control variables

All specifications include a common set of controls for firm characteristics and local conditions. These controls include firm-size categories, union presence, an indicator for no foreign ownership, the average age of regular employees and its square, industry fixed effects, year fixed effects, regional block fixed effects, and industry-specific linear trends. Year fixed effects absorb common macroeconomic shocks affecting all firms during the sample period, including the sharp shifts in *Shunto* settlement levels from 2022 to 2024 discussed in Section II. Industry-specific linear trends are included to absorb differential medium-run sectoral movements in wage-setting conditions during the sample period. Standard errors are clustered at the firm level. Although labor shortages can influence both training investment and wage adjustment, they may themselves be endogenous to prior training and retention strategies. I therefore include a lagged labor shortage indicator as a robustness check rather than as part of the main specification.

5. Wage increase incidence

To test Hypothesis 1, I estimate a probit model for the probability that firm i grants any wage increase in year t:

$$P(WageIncrease_{it} = 1) = \Phi\left(\alpha + \beta Z_{i,t-1} + \gamma X_{it} + \delta_s + \tau_t + \lambda_r + \theta_s t\right), \quad (1)$$

where $Z_{i,t-1}$ denotes one of the lagged training indicators or digitalization indicators included separately across specifications, X_{it} is the vector of control variables, δ_s are industry fixed effects, τ_t are year fixed effects, λ_r are regional block fixed effects, and $\theta_s t$ represents industry-specific linear trends. A positive and statistically significant association between the training variable and the probability of a wage increase is consistent with Hypothesis 1. I report average marginal effects (AME) for ease of interpretation.

6. Choice of wage adjustment instruments

To test Hypotheses 2 and 3, I restrict the sample to firms that granted wage increases and estimate a multivariate probit model for the joint choice of regular increases, base-up adjustments, and bonus increases. For each instrument $m \in \{regular, base\text{-}up, bonus\}$, the latent-variable specification is:

$$y^*_{mit} = \alpha_m + \beta_m Z_{i,t-1} + \gamma_m X_{it} + \delta_{ms} + \tau_{mt} + \lambda_{mr} + \theta_{ms} t + \varepsilon_{mit} \quad (2)$$

with observed outcomes

$$y_{mit} = 1 \text{ if } y^*_{mit} > 0, \ 0 \text{ otherwise.}$$

Here, $Z_{i,t-1}$ denotes one of the lagged training indicators or digitalization indicators entered separately across specifications. The error terms are assumed to follow a trivariate normal distribution with freely estimated correlations. This specification is appropriate because firms may choose multiple wage adjustment instruments simultaneously, and those choices are unlikely to be independent. Estimating the three equations jointly makes it possible to account for correlation in unobserved determinants across the three instrument choices. The estimated cross-equation error correlations are informative about whether the instruments tend to co-occur or move inversely after conditioning on the included covariates, although they are not by themselves sufficient to establish structural substitution or complementarity.

7. Interpretation

The estimates in this paper should be interpreted as conditional associations rather than definitive causal effects. Using lagged training indicators helps establish temporal ordering, and the specifications include a rich set of controls for firm characteristics, sector, region, and time. However, the analysis does not rely on an external exogenous shock or another research design that would fully eliminate reverse causality, selection, or omitted-variable concerns. In particular, firms with stronger expected performance, greater wage-setting capacity, or a broader managerial commitment to workforce development may be more likely both to invest in training and to raise wages. The empirical objective is therefore not to identify clean causal effects of training or digitalization, but to determine whether these firm-level organizational dimensions are systematically associated with wage adjustment decisions and instrument choices in the Japanese institutional setting, using separate specifications.

V. Results

This section presents the main empirical results for Hypotheses 1–3. I begin by examining whether firms that invest more actively in employee training are more likely to grant any wage increase. I then turn to the composition of wage adjustment among wage-increasing firms and ask whether training investment is associated with the choice of regular increases, base-up adjustments, and bonus increases. This sequence follows the paper's central argument: training investment may matter not only for whether firms raise wages, but also for how they distribute wage adjustments across compensation instruments that differ in permanence and cost implications.

1. Wage increase incidence

Table 1 reports average marginal effects from probit models of any wage increase. Descriptive statistics for the estimation samples used in Table 1 are reported in Appendix Table A1. Overall, the results are broadly consistent with Hypothesis 1. Firms that invested more actively in employee training in the previous year were, on average, more likely to grant wage increases in the following year. In particular, the presence of Off-JT, the existence of any training expenditure, a higher share of employees participating in training, and longer annual training hours per participant are positively associated with the probability of implementing a wage increase in many specifications.

The digitalization indicators, which are included as a secondary explanatory dimension, show a weaker and less uniform pattern. In particular, neither the digital technology use dummy nor the number of

Table 1. Average marginal effects from probit models of any wage increase

	OJT/Off-JT		Training expenditure		Training participation		Training hours		Digitalization	
Dependent variable: Any wage increase (=1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	AME	AME	AME	AME	AME	AME	AME	AME	AME	AME
Planned OJT	0.0166	0.0159								
	(0.0120)	(0.0120)								
Off-JT	0.0420***	0.0417***								
	(0.0109)	(0.0109)								
Any training expenditure			0.0606***	0.0504***						
			(0.0119)	(0.0148)						
Training expenditure / total cash earnings (log)			-0.0117	-0.00634						
			(0.00802)	(0.0173)						
Training participation (ref. none)										
<20%					0.0734***	0.0666***				
					(0.00938)	(0.0121)				
20–<40%					0.0815***	0.0764***				
					(0.0144)	(0.0182)				
40–<60%					0.0590***	0.0371*				
					(0.0180)	(0.0210)				
60–<80%					0.129***	0.122***				
					(0.0305)	(0.0436)				
≥80%					0.0894***	0.0478***				
					(0.0169)	(0.0184)				
Training hours per participant (ref. none)										
<1 day							0.0889***	0.0714***		
							(0.0133)	(0.0160)		
1–<2 days							0.0770***	0.0745***		
							(0.0107)	(0.0140)		
2–<4 days							0.0860***	0.0834***		
							(0.0128)	(0.0166)		
4–<6 days							0.103***	0.0606**		
							(0.0204)	(0.0237)		
6–<10 days							0.0728***	0.0960**		
							(0.0241)	(0.0473)		
≥10 days							0.0594***	0.0250		
							(0.0209)	(0.0217)		
Digital technology use									0.0151	0.0133
									(0.0197)	(0.0198)
Number of digital technologies (log)									0.0131	0.0146
									(0.0162)	(0.0164)
Labor shortage		0.0295***		0.0206**		0.0273***		0.0263***		0.0308***
		(0.00923)		(0.00990)		(0.00950)		(0.00953)		(0.00962)
Union present	0.0433*	0.0449*	0.0414**	0.0401	0.0344**	0.0465**	0.0303*	0.0481**	0.0407*	0.0422*
	(0.0230)	(0.0229)	(0.0196)	(0.0246)	(0.0167)	(0.0220)	(0.0168)	(0.0232)	(0.0227)	(0.0227)
Firm size (ref. 1–20 employees)										
21–100	0.0615***	0.0586***	0.0592***	0.0540***	0.0456***	0.0510***	0.0449***	0.0479***	0.0692***	0.0661***
	(0.0113)	(0.0112)	(0.0102)	(0.0116)	(0.00974)	(0.0116)	(0.00979)	(0.0115)	(0.0117)	(0.0115)
101–300	0.0813***	0.0766***	0.0657***	0.0671***	0.0471***	0.0579***	0.0467***	0.0506***	0.0867***	0.0810***
	(0.0198)	(0.0196)	(0.0161)	(0.0191)	(0.0156)	(0.0189)	(0.0156)	(0.0189)	(0.0200)	(0.0198)
301–499	0.0585**	0.0547**	0.0721***	0.0880**	0.0523***	0.0556**	0.0465**	0.0578*	0.0704***	0.0664**
	(0.0261)	(0.0262)	(0.0216)	(0.0349)	(0.0201)	(0.0263)	(0.0207)	(0.0308)	(0.0260)	(0.0261)
500+	0.115***	0.105***	0.0959***	0.0931***	0.0795***	0.0832**	0.0763***	0.108***	0.123***	0.113***
	(0.0353)	(0.0351)	(0.0264)	(0.0352)	(0.0245)	(0.0339)	(0.0246)	(0.0412)	(0.0353)	(0.0351)
No foreign ownership	0.00660	0.00940	0.0170	0.0179	-0.00178	0.00619	0.00450	0.0100	0.0113	0.0138
	(0.0209)	(0.0209)	(0.0189)	(0.0197)	(0.0184)	(0.0204)	(0.0183)	(0.0203)	(0.0210)	(0.0211)
Average age of regular employees	0.00808	0.00741	0.00676	-0.000126	0.00964*	0.000869	0.00850	0.000581	0.00611	0.00573
	(0.00599)	(0.00594)	(0.00552)	(0.00689)	(0.00539)	(0.00656)	(0.00542)	(0.00645)	(0.00623)	(0.00616)
Average age squared	-0.000132**	-0.000123**	-0.000131**	-3.98e-05	-0.000160***	-4.96e-05	-0.000150***	-4.86e-05	-0.000108*	-0.000102
	(6.28e-05)	(6.22e-05)	(5.79e-05)	(7.19e-05)	(5.63e-05)	(6.85e-05)	(5.67e-05)	(6.73e-05)	(6.56e-05)	(6.47e-05)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional block FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-specific linear trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,242	3,242	5,138	2,664	6,072	2,907	5,951	2,849	3,038	3,038

Notes: 1. Reported estimates are average marginal effects from probit models.
2. Standard errors clustered at the firm level are in parentheses. Columns (2), (4), (6), (8), and (10) additionally control for lagged labor shortage.
3. * p < 0.10, ** p < 0.05, *** p < 0.01.

digital technologies in use displays a clear and systematic relationship with wage increase incidence. This contrast suggests that, in the present data, training investment is more systematically associated with whether firms raise wages than digital technology adoption is.

The estimated magnitudes are substantively meaningful. Off-JT is associated with roughly a 4.2-percentage-point increase in the probability of granting a wage increase, while the existence of any training expenditure is associated with an increase of about 5–6 percentage points. Training participation and training hours also display positive associations, although the relationship is not strictly monotonic across categories. The results remain broadly similar when lagged labor shortages are added as a robustness check, suggesting that the estimated association between training and wage increase incidence is not driven solely by contemporaneous labor market tightness. Union presence and larger firm size are also positively associated with wage increase incidence.

2. Choice of wage adjustment instruments

For the instrument-choice analysis, I do not report specifications that include the lagged labor shortage indicator, because adding this variable substantially reduces the sample for the multivariate probit and, as shown in Table 1, leaves the training-related coefficients in the incidence models qualitatively unchanged.

Table 2 reports the multivariate probit estimates for the choice of wage adjustment instruments among firms that granted a wage increase. Descriptive statistics for this estimation sample are reported in Appendix Table A2. These estimates are conditional on wage increase incidence and therefore speak to the composition of wage adjustment within the subsample of wage-increasing firms, rather than to unconditional instrument use in the full sample.

The results indicate that training investment is associated not only with the decision to raise wages but also with how wage adjustments are allocated across instruments. In broad terms, the training measures are more consistently associated with base-up adjustments and bonus increases than with regular increases, which is consistent with Hypotheses 2 and 3. Planned OJT and Off-JT exhibit different patterns across the two dimensions of wage adjustment. Planned OJT is positively associated with base-up adjustments and bonus increases but not with wage increase incidence, whereas Off-JT shows the opposite pattern, being positively associated with incidence but not with the choice of any particular instrument. One reading of this contrast, consistent with the Japanese workplace-based skill-formation literature (Koike 2005; Owan 2004), is that workplace-based and institutionalized training may operate through different channels in firms' wage-setting decisions. While the present analysis does not identify the underlying mechanism, a fuller understanding of the OJT–Off-JT asymmetry is left for future research.

The remaining training indicators reinforce this interpretation. Most strikingly, the intensity of training expenditure—measured as the log-transformed ratio of training expenditure to total cash earnings—is negatively and significantly associated with regular increases (approximately -0.08) and positively and significantly associated with base-up adjustments (approximately +0.08), while its association with bonus increases is not statistically significant. This contrast is the most pronounced asymmetry across the training indicators and is consistent with Hypothesis 2. Higher training participation rates and longer annual training hours also tend to be more closely associated with base-up adjustments and bonus increases than with regular increases, although the category patterns are not fully monotonic. Because the estimates are multivariate probit coefficients, these contrasts are best interpreted as differences in conditional association rather than as direct evidence of substitution across instruments.

In addition, the estimated error correlations show a distinctive asymmetric pattern. The correlation between regular increases and base-up adjustments (rho21) is negative and highly significant (approximately -0.53 to -0.56), and the correlation between regular increases and bonus increases (rho31) is also negative and significant, though

Table 2. Multivariate probit estimates for the choice of wage adjustment instruments

	OJT/Off-JT			Training expenditure			Training participation			Training hours			Digitalization		
	(1)			(2)			(3)			(4)			(5)		
	Regular	Base-up	Bonus	Regular	Base-up	Bonus	Regular	Base-up	Bonus	Regular	Base-up	Bonus	Regular	Base-up	Bonus
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Planned OJT	0.0157	0.167***	0.148**												
	(0.0664)	(0.0580)	(0.0575)												
Off-JT	0.0921	0.0870	-0.0169												
	(0.0647)	(0.0566)	(0.0554)												
Any training expenditure				0.132**	0.151***	0.172***									
				(0.0607)	(0.0508)	(0.0520)									
Training expenditure / total cash earnings (log)				-0.0829*	0.0811**	-0.0410									
				(0.0452)	(0.0397)	(0.0384)									
Training participation (ref. none)															
<20%							0.116**	0.172***	0.162***						
							(0.0553)	(0.0485)	(0.0493)						
20–<40%							0.224***	0.196***	0.237***						
							(0.0745)	(0.0632)	(0.0627)						
40–<60%							0.141	0.265***	0.208**						
							(0.0983)	(0.0826)	(0.0822)						
60–<80%							0.144	0.378***	0.276***						
							(0.121)	(0.0987)	(0.0956)						
≥80%							0.193**	0.217***	0.228***						
							(0.0853)	(0.0720)	(0.0729)						
Training hours per participant (ref. none)															
<1 day										0.115	0.144**	0.0612			
										(0.0721)	(0.0631)	(0.0639)			
1–<2 days										0.212***	0.171***	0.187***			
										(0.0633)	(0.0539)	(0.0539)			
2–<4 days										0.108	0.222***	0.301***			
										(0.0671)	(0.0580)	(0.0596)			
4–<6 days										0.137	0.375***	0.280***			
										(0.0913)	(0.0810)	(0.0785)			
6–<10 days										-0.0510	0.0547	0.324***			
										(0.114)	(0.100)	(0.102)			
≥10 days										0.000511	0.336***	0.215**			
										(0.109)	(0.101)	(0.0998)			
Digital technology use													-0.0126	-0.000834	-0.216**
													(0.122)	(0.108)	(0.107)
Number of digital technologies (log)													0.0640	0.179**	0.310***
													(0.0888)	(0.0769)	(0.0761)

Table 2. Continued

	OJT/Off-JT			Training expenditure			Training participation			Training hours			Digitalization		
	(1)			(2)			(3)			(4)			(5)		
	Regular	Base-up	Bonus	Regular	Base-up	Bonus	Regular	Base-up	Bonus	Regular	Base-up	Bonus	Regular	Base-up	Bonus
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Union present	0.273**	0.203**	-0.0378	0.147*	0.227***	-0.0137	0.138*	0.202***	-0.0419	0.144*	0.186***	-0.0293	0.305***	0.208**	-0.0878
	(0.107)	(0.0873)	(0.0803)	(0.0868)	(0.0693)	(0.0658)	(0.0814)	(0.0640)	(0.0607)	(0.0836)	(0.0649)	(0.0622)	(0.110)	(0.0891)	(0.0830)
Firm size															
(ref. 1–20 employees)															
21–100	0.336***	0.0505	-0.0223	0.299***	0.0425	0.00738	0.295***	0.00514	-0.00669	0.294***	0.00948	-0.00175	0.343***	0.0477	-0.0235
	(0.0743)	(0.0651)	(0.0652)	(0.0613)	(0.0526)	(0.0531)	(0.0580)	(0.0500)	(0.0505)	(0.0582)	(0.0502)	(0.0506)	(0.0769)	(0.0671)	(0.0677)
101–300	0.399***	0.125	-0.202**	0.472***	0.0254	-0.136*	0.452***	-0.0239	-0.152**	0.462***	-0.0121	-0.149**	0.441***	0.102	-0.225**
	(0.109)	(0.0905)	(0.0906)	(0.0952)	(0.0768)	(0.0755)	(0.0868)	(0.0718)	(0.0708)	(0.0876)	(0.0722)	(0.0709)	(0.116)	(0.0939)	(0.0946)
301–499	0.401***	0.182	-0.281**	0.584***	0.0851	-0.231***	0.531***	0.0474	-0.160*	0.518***	0.0495	-0.156*	0.423***	0.169	-0.350***
	(0.139)	(0.120)	(0.113)	(0.117)	(0.0906)	(0.0892)	(0.104)	(0.0848)	(0.0838)	(0.108)	(0.0878)	(0.0861)	(0.141)	(0.123)	(0.116)
500+	0.559***	0.293**	-0.349***	0.626***	0.0317	-0.359***	0.615***	0.0197	-0.372***	0.652***	0.0549	-0.347***	0.573***	0.289**	-0.420***
	(0.146)	(0.119)	(0.117)	(0.116)	(0.0915)	(0.0932)	(0.110)	(0.0865)	(0.0878)	(0.115)	(0.0872)	(0.0894)	(0.149)	(0.122)	(0.123)
No foreign ownership	0.231*	-0.312***	-0.0695	0.101	-0.152*	-0.179**	0.0872	-0.132	-0.150*	0.103	-0.161*	-0.141*	0.198	-0.302***	-0.0449
	(0.122)	(0.112)	(0.110)	(0.108)	(0.0899)	(0.0891)	(0.0970)	(0.0826)	(0.0809)	(0.0974)	(0.0830)	(0.0824)	(0.127)	(0.113)	(0.113)
Average age of regular employees	0.0764*	0.0366	-0.0820**	0.108***	-0.0150	-0.0315	0.140***	-0.0236	-0.0372	0.134***	-0.0209	-0.0411	0.0655	0.0345	-0.0895**
	(0.0435)	(0.0385)	(0.0398)	(0.0339)	(0.0319)	(0.0311)	(0.0323)	(0.0295)	(0.0296)	(0.0324)	(0.0293)	(0.0295)	(0.0459)	(0.0403)	(0.0414)
Average age squared	-0.00114**	-0.000533	0.000822*	-0.00144***	2.63e-05	0.000288	-0.00175***	0.000138	0.000357	-0.00171***	0.000115	0.000404	-0.00104**	-0.000511	0.000914**
	(0.000477)	(0.000428)	(0.000440)	(0.000371)	(0.000356)	(0.000345)	(0.000357)	(0.000328)	(0.000328)	(0.000358)	(0.000326)	(0.000327)	(0.000504)	(0.000449)	(0.000460)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional block FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-specific linear trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.833	-0.142	1.842**	-1.350*	0.286	0.661	-2.132***	0.494	0.734	-2.009***	0.434	0.789	-0.539	-0.189	1.886**
	(1.003)	(0.876)	(0.906)	(0.775)	(0.717)	(0.704)	(0.735)	(0.666)	(0.667)	(0.739)	(0.663)	(0.667)	(1.052)	(0.911)	(0.937)
rho21		-0.5280***			-0.5552***			-0.5582***			-0.5639***			-0.5258***	
		(0.0294)			(0.0233)			(0.0215)			(0.0217)			(0.0306)	
rho31		-0.1469***			-0.1560***			-0.1662***			-0.1717***			-0.1382***	
		(0.0344)			(0.0278)			(0.0256)			(0.0258)			(0.0358)	
rho32		-0.0045			0.0280			0.0226			0.0169			-0.0139	
		(0.0312)			(0.0254)			(0.0232)			(0.0235)			(0.0321)	
Observations		2,930			4,558			5,383			5,263			2,750	

Notes: 1. The table reports coefficient estimates from multivariate probit models for the joint choice of regular increases, base-up adjustments, and bonus increases among firms that granted a wage increase.
2. Standard errors clustered at the firm level are in parentheses.
3. The estimated error correlations capture the dependence across the three wage adjustment instruments. * p < 0.10, ** p < 0.05, *** p < 0.01.

smaller in magnitude (-0.14 to -0.17). In contrast, the correlation between base-up adjustments and bonus increases (rho32) is consistently small and statistically insignificant across specifications. This pattern is consistent with the possibility that regular increases are treated as partial alternatives to base-up and bonus adjustments, conditional on the included covariates. There is no evidence that firms offset base-up adjustments with smaller bonuses, or vice versa.

The digitalization indicators also exhibit a distinctive pattern in the instrument-choice analysis. Although they are secondary to the training variables in the design of the paper, they are substantively informative. In particular, the number of digital technologies in use is positively and significantly associated with both base-up adjustments and bonus increases, whereas the simple digital technology use dummy is negatively associated with bonus increases. These estimates suggest that the depth of digitalization, rather than its mere presence, may be associated with how firms allocate wage adjustments across instruments.

Overall, the multivariate probit results provide qualified support for Hypotheses 2 and 3. Training investment is associated not only with whether firms raise wages, but also with how they structure wage adjustments across instruments. The evidence is broadly consistent with the expectation that training indicators are more consistently associated with base-up adjustments and, in many cases, bonus increases than with regular increases alone. At the same time, the results are not fully uniform across all training indicators: several training variables show non-monotonic patterns across categories. These findings suggest that the link between training and wage adjustment is better understood as a differentiated allocation process than as a simple one-to-one relationship between training and fixed-pay growth.

Beyond the training and digitalization indicators, the control variables also display patterns consistent with prior literature on the Japanese wage-setting system. Union presence is positively associated with regular increases and base-up adjustments but not with bonus increases, broadly in line with the *Shunto* literature emphasizing enterprise unions' focus on fixed-pay components (Hara and Kawaguchi 2008; Kato 2016). Firm size shows a differentiated pattern across instruments, with larger firms more likely to use regular increases and less likely to use bonuses, consistent with more institutionalized internal labor markets in larger Japanese firms.

VI. Discussion

The findings suggest that firm-sponsored training is associated with wage adjustment through more than one margin. At the broadest level, firms that institutionalize training through Off-JT, training expenditure, broader participation, and longer training time are more likely to grant wage increases in the following year. At the same time, the instrument-choice results indicate that these associations are not distributed uniformly across pay components. Several training indicators are more consistently associated with base-up adjustments and bonus increases than with regular increases. This implies that the relationship between training and wages is not fully captured by a single wage outcome, but instead depends on how firms allocate compensation across instruments that differ in permanence and cost implications under the Japanese wage-setting system.

Moreover, the estimated error correlations across wage instruments show that these choices are not independent. The negative and significant correlations involving regular increases are consistent with the possibility that firms treat regular increases as partial alternatives to base-up and bonus adjustments. However, the correlation between base-up and bonus adjustments is not statistically significant, indicating no clear evidence that unobserved determinants of the two instruments move systematically in opposite directions once firm characteristics are controlled for. Taken together, these results reinforce the view that the employment relationship mediates not only whether productivity-related gains are shared with workers, but also the organizational form—schedule-based commitment,

flexible distribution, or a combination of both—in which that sharing occurs.

A related observation concerns the role of digitalization. Although digitalization is not the main explanatory focus of the paper, the estimates suggest that it captures a substantively meaningful organizational dimension of wage-setting behavior. In the wage increase incidence analysis (Table 1), neither the digital technology use dummy nor the number of digital technologies in use is significantly associated with the probability of granting a wage increase. In the instrument-choice analysis (Table 2), however, the depth of digitalization—measured by the number of digital technologies in use—is positively and significantly associated with both base-up adjustments and bonus increases, while the simple use dummy is negatively associated with bonus increases. One interpretation is that broader digital adoption serves as a marker of firms that are reorganizing work processes and therefore differ in how they structure wage adjustments, even if digitalization by itself does not predict whether they raise wages at all. This interpretation remains tentative, but it suggests that the technological environment may matter for the composition of wage adjustment even when it is not the primary driver of wage increase incidence.

Several limitations should be noted. First, the analysis relies on firm-level measures of training and therefore cannot identify how the relationship between training and wage adjustment varies across occupations, job tasks, or individual workers. Second, although all training variables are lagged, the empirical design does not fully rule out reverse causality or omitted-variable bias. Firms with greater wage-setting capacity may also be more likely to invest in training, and both decisions may be jointly shaped by unobserved managerial strategy or firm performance. Third, the data combine surveys of smaller and larger firms, and the number of large firms remains relatively limited in some specifications. Fourth, because the instrument-choice analysis conditions on wage increase incidence, the second-stage estimates should be interpreted as evidence on the composition of wage adjustment among wage-increasing firms rather than as unconditional evidence on instrument choice in the full population of firms.

In addition, the instrument-choice analysis excludes a small group of firms that granted wage increases outside the three focal instruments, and the broader empirical design focuses mainly on wage adjustment for regular employees, which reflects the central role of regular-employee pay in *Shunto*-based wage setting. As Yokoyama et al. (2021) emphasize, Japanese firms also adjust along the non-regular employment margin in response to exogenous shocks, and recent work suggests that the division between regular and non-regular workers increasingly shapes aggregate wage dynamics (Kawaguchi et al. 2021). These features do not invalidate the findings, but they suggest that the estimates should be interpreted as evidence on systematic firm-level associations—in particular, on the wage adjustment process among regular employees—rather than as definitive causal effects.

Despite these limitations, the findings have implications for both industrial relations scholarship and policy debates on wage growth. The results indicate that training investment is related not only to whether firms raise wages, but also to how they distribute wage adjustments across fixed-pay and more flexible pay instruments. This suggests that policies promoting human capital investment may influence wage-setting institutions indirectly, by shaping the organizational conditions under which firms choose between regular increases, base-up adjustments, and bonus increases. More broadly, the paper shows that the translation of skill formation into pay depends on institutional structure rather than on productivity alone. Future research could build on this by examining occupational heterogeneity, non-regular workers, and the interaction between training, digitalization, and bargaining institutions in greater detail.

VII. Conclusion

This paper has examined how firm-sponsored training is associated with wage adjustment in

Japanese firms. Using three waves of the JILPT Corporate Panel Survey, I analyzed two related dimensions of wage adjustment: whether firms grant any wage increase and, among wage-increasing firms, which wage adjustment instruments they use. This approach was motivated by the idea that the relationship between training and wages should not be reduced to a single outcome. In the Japanese institutional context, firms can translate workforce-related commitments into different pay instruments, including regular increases, base-up adjustments, and bonus increases, each of which differs in permanence and cost implications.

The results provide evidence that training investment is systematically associated with firms' wage adjustment behavior. Firms that implemented Off-JT, incurred training expenditure, trained a broader share of employees, or provided longer annual training hours were, on average, more likely to grant wage increases in the following year. In addition, among firms that granted wage increases, several training indicators are more consistently associated with base-up adjustments and bonus increases than with regular increases. These findings suggest that training investment is related not only to whether firms raise wages, but also to how wage adjustments are structured across instruments with different degrees of permanence and cost implications.

More broadly, the paper suggests that training investment is linked to wage adjustment in Japan through both wage increase incidence and the composition of those increases, while digitalization appears to play a secondary but relevant role in this process.

This article is a revised and adapted version of Chapter 4, "Hito e no toshi to chinage kodo" [Investment in Human Resources and Wage Adjustment Behavior], which was originally written by the author for JILPT Research Series No. 262, entitled "Hito e no toshi to kigyo senryaku ni kansuru paneru chosa (JILPT kigyo paneru chosa, Dai 3-kai): Kigyo no chinage ni chakumoku shite" [Panel Survey on Investment in Human Resources and Corporate Strategies (the JILPT Corporate Panel Survey, the Third Wave): Focusing on Japanese firms' wage adjustment behavior]. The present version has been revised and updated in line with the editorial focus of *Japan Labor Issues*.

Notes

1. In the Japanese wage-setting context, regular increases generally follow existing pay progression rules, base-up adjustments raise the wage schedule itself, and bonus increases provide a more flexible channel of compensation.
2. The analysis uses the first three waves of the JILPT Corporate Panel Survey and constructs pooled firm-year observations from the available panel responses. I do not adopt firm fixed-effects specifications as the main estimation strategy because only about one quarter of firms are observed in all three waves, several training indicators exhibit limited within-firm variation, and the multivariate probit model used for the instrument-choice analysis does not admit a computationally tractable fixed-effects implementation.
3. These 166 firms, representing 2.1 percent of the 7,789 wage-increasing firms in the pooled three-year data, reported wage increases only through instruments outside the three focal categories. Because the survey instructs respondents to mark the three focal options only when the wage adjustment primarily targets regular employees, these firms may include cases in which wage increases were targeted at non-regular workers. Their exclusion is consistent with the paper's focus on wage adjustment for regular employees and does not alter the main interpretation.
4. The training expenditure ratio takes the value of zero for firms that reported no training expenditure during the previous fiscal year. To retain these observations in the estimation sample under a logarithmic specification, I use log(1 + ratio) rather than the natural logarithm of the ratio itself.
5. Because the number of digital technology items includes zero, I use log(items + 1).

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HE Fang

Vice Senior Researcher, The Japan Institute for Labour Policy and Training. Research interests: Labor economics.
https://www.jil.go.jp/english/profile/he.html

Appendix Tables

Table A1. Descriptive statistics for the wage increase incidence sample

	OJT/Off-JT specifications		Training expenditure specifications				Training participation specifications				Training hours specifications				Digitalization specifications	
	(1) / (2)		(3)		(4)		(5)		(6)		(7)		(8)		(9) / (10)	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Any wage increase (=1)	0.924	0.265	0.906	0.292	0.927	0.260	0.904	0.295	0.925	0.263	0.902	0.297	0.925	0.264	0.925	0.264
Planned OJT	0.355	0.479														
Off-JT	0.467	0.499														
Any training expenditure			0.516	0.500	0.456	0.498										
Training expenditure / total cash earnings (log)			0.405	0.675	0.197	0.398										
Training participation																
none							0.302	0.459	0.281	0.450						
<20%							0.379	0.485	0.361	0.480						
20–<40%							0.137	0.343	0.151	0.358						
40–<60%							0.057	0.232	0.065	0.247						
60–<80%							0.036	0.186	0.042	0.201						
≥80%							0.090	0.286	0.100	0.300						
Training hours per participant																
none											0.307	0.461	0.283	0.450		
<1 day											0.131	0.337	0.140	0.347		
1–<2 days											0.249	0.432	0.258	0.438		
2–<4 days											0.175	0.380	0.180	0.384		
4–<6 days											0.064	0.245	0.063	0.243		
6–<10 days											0.034	0.182	0.034	0.182		
≥10 days											0.040	0.196	0.042	0.200		
Digital technology use															0.782	0.413
Number of digital technologies (log)															0.954	0.623
Labor shortage	0.593	0.491			0.598	0.490			0.590	0.492			0.591	0.492	0.591	0.492
Union present	0.133	0.340	0.141	0.348	0.137	0.344	0.140	0.347	0.142	0.349	0.136	0.343	0.139	0.346	0.136	0.343
Firm size																
1–20 employees	0.330	0.470	0.342	0.474	0.336	0.473	0.340	0.474	0.332	0.471	0.346	0.476	0.338	0.473	0.325	0.468
21–100	0.392	0.488	0.380	0.485	0.386	0.487	0.379	0.485	0.381	0.486	0.382	0.486	0.385	0.487	0.391	0.488
101–300	0.135	0.342	0.124	0.330	0.126	0.332	0.127	0.333	0.129	0.336	0.127	0.333	0.129	0.335	0.136	0.342
301–499	0.070	0.255	0.075	0.263	0.075	0.263	0.075	0.263	0.076	0.266	0.069	0.254	0.071	0.257	0.072	0.258
500+	0.073	0.260	0.078	0.269	0.078	0.268	0.080	0.271	0.081	0.273	0.076	0.265	0.077	0.266	0.076	0.266
No foreign ownership	0.945	0.228	0.947	0.224	0.946	0.226	0.945	0.228	0.946	0.225	0.944	0.229	0.945	0.228	0.944	0.231
Average age of regular employees	44.402	6.438	44.245	6.526	44.518	6.434	44.191	6.454	44.441	6.395	44.240	6.494	44.488	6.429	44.336	6.406
Average age squared	2012.9	591.5	2000.2	598.8	2023.3	591.8	1994.5	591.6	2015.9	586.8	1999.4	595.9	2020.5	590.7	2006.7	587.4
Industry																
Construction	0.170	0.376	0.166	0.372	0.172	0.377	0.163	0.369	0.166	0.373	0.163	0.369	0.167	0.373	0.169	0.375
Manufacturing	0.249	0.432	0.243	0.429	0.243	0.429	0.249	0.432	0.248	0.432	0.248	0.432	0.247	0.431	0.255	0.436
Transport	0.048	0.215	0.049	0.217	0.049	0.215	0.049	0.216	0.050	0.217	0.049	0.216	0.049	0.217	0.048	0.214
Information and communications	0.069	0.254	0.069	0.254	0.071	0.257	0.066	0.249	0.067	0.251	0.065	0.247	0.066	0.248	0.070	0.256
Wholesale and retail	0.280	0.449	0.281	0.449	0.281	0.449	0.284	0.451	0.286	0.452	0.289	0.453	0.291	0.454	0.275	0.447
Services	0.132	0.339	0.135	0.341	0.136	0.342	0.131	0.338	0.132	0.339	0.129	0.335	0.128	0.334	0.133	0.339
Other	0.052	0.222	0.056	0.230	0.049	0.216	0.058	0.233	0.050	0.218	0.058	0.234	0.052	0.221	0.050	0.217
Regional block																
Hokkaido	0.059	0.236	0.059	0.235	0.058	0.234	0.057	0.232	0.058	0.234	0.057	0.232	0.058	0.234	0.058	0.233
Tohoku	0.071	0.256	0.070	0.256	0.076	0.265	0.070	0.255	0.073	0.259	0.069	0.254	0.071	0.257	0.070	0.256
Kanto	0.339	0.473	0.336	0.472	0.331	0.471	0.337	0.473	0.335	0.472	0.338	0.473	0.335	0.472	0.341	0.474
Chubu	0.184	0.387	0.182	0.386	0.185	0.388	0.184	0.387	0.186	0.389	0.184	0.387	0.186	0.389	0.185	0.389
Kinki	0.174	0.379	0.182	0.386	0.178	0.382	0.178	0.383	0.175	0.380	0.178	0.382	0.177	0.381	0.173	0.378
Chugoku	0.071	0.257	0.064	0.245	0.067	0.250	0.067	0.250	0.071	0.256	0.066	0.248	0.070	0.255	0.071	0.258
Shikoku	0.029	0.167	0.033	0.177	0.031	0.174	0.032	0.176	0.030	0.170	0.032	0.177	0.031	0.172	0.029	0.167
Kyushu and Okinawa	0.075	0.263	0.073	0.261	0.073	0.261	0.076	0.264	0.073	0.261	0.076	0.265	0.074	0.261	0.072	0.259
Survey-year																
2022	0.000	0.000	0.390	0.488	0.000	0.000	0.436	0.496	0.000	0.000	0.437	0.496	0.000	0.000	0.000	0.000
2023	0.524	0.499	0.361	0.480	0.538	0.499	0.343	0.475	0.557	0.497	0.342	0.475	0.557	0.497	0.493	0.500
2024	0.476	0.499	0.249	0.433	0.462	0.499	0.221	0.415	0.443	0.497	0.221	0.415	0.443	0.497	0.507	0.500
Observations	3,242		5,138		2,664		6,072		2,907		5,951		2,849		3,038	

Notes: 1. Columns correspond to the samples used in Table 1.
2. Columns (2), (4), (6), (8), and (10) additionally include lagged labor shortage.
3. Reported values are means and standard deviations.

Table A2. Descriptive statistics for the instrument-choice sample

	OJT/Off-JT specifications		Training expenditure specifications		Training participation specifications		Training hours specifications		Digitalization specifications	
	(1)		(2)		(3)		(4)		(5)	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Regular (=1)	0.785	0.411	0.800	0.400	0.798	0.401	0.795	0.403	0.788	0.409
Base-up (=1)	0.587	0.492	0.525	0.499	0.511	0.500	0.510	0.500	0.598	0.490
Bonus (=1)	0.422	0.494	0.408	0.491	0.403	0.491	0.407	0.491	0.418	0.493
Planned OJT	0.376	0.485								
Off-JT	0.496	0.500								
Any training expenditure			0.544	0.498						
Training expenditure / total cash earnings (log)			0.414	0.670						
Training participation										
none					0.266	0.442				
<20%					0.395	0.489				
20–<40%					0.146	0.353				
40–<60%					0.059	0.236				
60–<80%					0.039	0.195				
≥80%					0.095	0.293				
Training hours per participant										
none							0.269	0.444		
<1 day							0.135	0.342		
1–<2 days							0.262	0.440		
2–<4 days							0.187	0.390		
4–<6 days							0.068	0.252		
6–<10 days							0.036	0.187		
≥10 days							0.041	0.198		
Digital technology use									0.799	0.401
Number of digital technologies (log)									0.984	0.617
Union present	0.144	0.352	0.152	0.360	0.152	0.359	0.147	0.355	0.147	0.354
Firm size										
1–20 employees	0.298	0.457	0.309	0.462	0.308	0.462	0.315	0.464	0.292	0.455
21–100	0.404	0.491	0.394	0.489	0.391	0.488	0.395	0.489	0.405	0.491
101–300	0.143	0.350	0.132	0.339	0.134	0.341	0.135	0.341	0.144	0.351
301–499	0.074	0.262	0.079	0.270	0.079	0.270	0.073	0.260	0.076	0.265
500+	0.080	0.271	0.085	0.279	0.087	0.282	0.082	0.275	0.084	0.277
No foreign ownership	0.946	0.227	0.947	0.224	0.944	0.229	0.944	0.230	0.945	0.229
Average age of regular employees	43.928	6.047	43.715	6.108	43.674	6.045	43.710	6.082	43.880	6.021
Average age squared	1966.2	546.1	1948.3	549.6	1943.9	543.5	1947.5	547.3	1961.7	543.1
Industry										
Construction	0.171	0.376	0.169	0.375	0.166	0.372	0.166	0.372	0.171	0.376
Manufacturing	0.256	0.436	0.255	0.436	0.259	0.438	0.259	0.438	0.261	0.440
Transport	0.048	0.213	0.046	0.209	0.046	0.209	0.046	0.209	0.048	0.214
Information and communications	0.072	0.259	0.073	0.260	0.069	0.254	0.068	0.251	0.074	0.262
Wholesale and retail	0.277	0.448	0.277	0.448	0.281	0.449	0.285	0.452	0.272	0.445
Services	0.130	0.336	0.132	0.339	0.128	0.334	0.125	0.331	0.131	0.337
Other	0.046	0.210	0.048	0.214	0.051	0.221	0.052	0.221	0.043	0.204
Regional block										
Hokkaido	0.061	0.239	0.060	0.238	0.059	0.235	0.059	0.236	0.059	0.236
Tohoku	0.071	0.256	0.070	0.256	0.070	0.255	0.069	0.253	0.071	0.256
Kanto	0.331	0.471	0.330	0.470	0.333	0.471	0.335	0.472	0.333	0.472
Chubu	0.189	0.391	0.186	0.389	0.186	0.389	0.186	0.389	0.191	0.393
Kinki	0.173	0.378	0.184	0.388	0.179	0.384	0.179	0.383	0.172	0.377
Chugoku	0.074	0.262	0.066	0.248	0.070	0.255	0.068	0.252	0.075	0.263
Shikoku	0.028	0.166	0.031	0.174	0.031	0.173	0.031	0.174	0.028	0.166
Kyushu and Okinawa	0.074	0.261	0.072	0.258	0.073	0.260	0.073	0.260	0.071	0.257
Survey-year										
2022	0.000	0.000	0.382	0.486	0.428	0.495	0.428	0.495	0.000	0.000
2023	0.522	0.500	0.363	0.481	0.346	0.476	0.346	0.476	0.491	0.500
2024	0.478	0.500	0.255	0.436	0.226	0.418	0.226	0.418	0.509	0.500
Observations	2,930		4,558		5,383		5,263		2,750	

Notes: 1. Columns correspond to the samples used in Table 2.
2. Reported values are means and standard deviations.