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Biases in Subjective Performance Evaluation*

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Abstract

We develop a theoretical model of subjective performance evaluation by the supervisor with possible discriminatory taste against the subordinate and imperfect observability of the latter's output. We assume that characteristic differences between the supervisor and the subordinate affect the precision of information that the former acquires through workplace interactions. We test the empirical predictions of the model using personnel data of a large manufacturing company in Japan. The following three findings corroborate the supervisor's learning of the subordinate's true ability: (1) supervisors give more candid evaluation of their subordinates whose job tenure in the current position is longer; (2) supervisors tend to give more candid evaluation of their subordinates who share the same demographic characteristics such as family structure, education, and age; and (3) supervisors' learning of worker ability seems to be slower for female workers than for males. We do not find any noticeable tendency that supervisors give more favorable evaluation to subordinates in the same social category.

Keywords: Subjective evaluation, Employer learning, Discrimination
JEL classification: D83, J31, J71, M52

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1. Introduction

A worker's output is not objectively observed in many work places and subjective evaluation of the worker by a supervisor is pervasive and plays a significant role in determining pay, job assignment, and promotion of the worker. Regardless of the importance of the subjective evaluation in organizations, economists have relatively scarce knowledge on how the subjective evaluations are formed by a supervisor compared with the knowledge on the relationship between the subjective performance evaluation and experience (Medoff and Abraham 1980) or the optimal contract design how the subjective evaluation and compensation should be related (Baker 2000, 2002 and MacLeod 2003).

Understanding how subjective evaluation is formed is practically important because some criticize subjective evaluation as the hotbed of discrimination against minority due to its subjective nature—a systematic bias in evaluation causes one group of employees to be disadvantaged in pay and promotion—or some complain the distribution of subjective evaluation is too compressed to be informative. Both mean biased and attenuation biased subjective performance evaluation result in misallocation of talents within an organization that could significantly lower the organization's productivity. For example, Neumark and McLennan (1995) and Johnson and Neumark (1997) report that minority workers who report they experience discrimination are more

likely to leave their employers. Takahashi, Owan, Tsuru, and Uehara (2014) report that biased evaluation increases subsequent quitting probability of workers who receive biased evaluation.

Attenuation bias, in addition to mean shifting bias, of subjective evaluation against minority plays an important role to explain why minority workers are less likely to be promoted to management positions. When the standard for promotion is higher than the average performance, attenuation of evaluation reduces the number of those who exceed the threshold. This distortion in job assignment may be even greater when the employee's performance is substantially affected by a random shock, because the employer sets a strict standard for promotion taking future mean reversion of the employee's performance into the consideration as is discussed in Lazear (2004).

We contributes to the literature on subjective performance evaluation by developing a behavioral model of the supervisor who gives subjective performance evaluation of the subordinate and testing the empirical predictions of the model using personnel data of a large-scale manufacturing company in Japan. The proposed model, build upon the model of favoritism by Prendergast and Topel (1996), has three-layer structure in which both the management and the supervisor evaluate the same subordinate and both the management and the supervisor independently observe noisy measures of the output by the subordinate. The supervisor is inclined to give biased

evaluation to satisfy his discriminatory taste but he is punished if his evaluation deviates from the observed output by the management. In this model setting, the supervisor has an incentive to report the subjective performance evaluation different from the observed output to satisfy the taste of discrimination and to approximate his evaluation to the subordinate's output observed by the management. The supervisor optimally chooses the degree of bias balancing these two counteracting forces.

Our theory explains two distinct types of evaluation bias. First, the supervisor gives preferential rating toward the subordinate belonging to a specific social category. For example, the supervisor may give preferential evaluation to those in the same social category as himself. Such own-group bias is reported for decisions in hiring, layoff, and promotion at a store chains studied by Giuliano, Levine, and Leonard (2009, 2011). Second, the supervisor gives more compressed evaluation rating to the subordinate whose output is observed with significant error. For example, the supervisor may give attenuated evaluation to the worker who is new to the current position and whose true ability is not yet fully revealed. For another example, the supervisor may give attenuated evaluation of those in different social categories because he has less information for judging his subordinate's performance. This view echoes *the language theory of discrimination* by Lang (1984), which postulates the communication cost incurred when minority and majority workers communicate because they do not share

the same language, culture or social norm. The theory predicts that minority and majority workers tend to segregate to save the communication cost.

Our study is also related to the literature of employer learning. Although usual discussion on whether employer learning is "public" or "private" looks at the firm-level learning in the labor market (Schönberg 2007, Pinkston 2009, Kim and Usui 2012, and Kahn 2013), the same question can be extended to the intra-firm learning at the supervisor level. Namely, a supervisor's learning of his/her subordinate's ability may be perfectly shared with other managers (public) or may not be transmitted to others (private). This issue could be examined by looking at a change in the distribution of evaluation at the time when supervisor-subordinate relationships break as the result of either one's transfer, relocation or separation.

We test the predictions from our theoretical model using personnel records from a large Japanese manufacturing company. This unique panel data of employee include the information on the supervisor and subordinate pair as well as information on annual evaluation, job grade, tenure in the current position, family composition of the supervisor and the subordinate. We regress both high and low evaluations of a subordinate on both the supervisor's and subordinate's demographic characteristics and their tenure in the current position. In the estimation, we allow for the subordinate's

fixed effects to capture the unobserved ability of the subordinate and the workplace fixed effects to capture the heterogeneity of job types that could affect the evaluation.

We postulate that public learning is reflected in *the company tenure effect* while private learning may be captured by *the tenure in the current work-group* or by *the length of current supervisor-subordinate relationship*.[1] We find that a supervisor is more likely to give both high and low evaluations on a subordinate who stays in the current position longer even after controlling for the tenure with the company, supporting the private learning hypothesis. This finding also corroborates with the theoretical prediction that the supervisor gives candid evaluation of the subordinate when the supervisor has more accurate information on the subordinate's performance because the supervisor obtains more accurate information on the subordinate's output as the subordinate stays longer in the current position. This effect of tenure on the current position also enables us to measure how quickly the supervisor learns the ability of his/her subordinates—the speed of learning by the supervisor.

We further find suggestive evidence that the supervisor and subordinate pair sharing the same family background tends to result in more candid evaluation. This finding is consistent with our theoretical prediction because sharing similar family

[1] We ended up using the *current-work-group tenure* in our estimates because we had a left-censoring problem for *the length of current supervisor-subordinate relationship* due to the fact that the supervisor was identified only in 2006 and after whereas the workplace assignment information can be traced back to 1990s.

background arguably facilitates communications between the supervisor and the subordinate and improve the measurement accuracy of the subordinate's output.

On the other hand, we did not find any clear tendency that the supervisor gives more discriminatory evaluation to the subordinate belonging to a different social category in terms of marital status or gender. This result, combined with the finding for the candidness of evaluation, suggest that the mean biased evaluation is less likely than the attenuation biased evaluation.

As a further suggestive evidence for the attenuation bias, we find that the supervisors' learning speed might be slower for female subordinates than for male subordinates. While the evidence is not strong, this finding corroborates with the attenuation bias for women. This finding is probably due to the fact that most managers are male; in this situation, female subordinates may have less opportunity to communicate with their supervisors and to send credible signal on their ability.

Our empirical evidence on the biases of subjective performance is unique in three aspects. First, prior empirical works on the subjective evaluation bias only focus on the mean bias. For example, Elvira and Town (2001) find that Caucasian (African-American) supervisors tend to give lower grades to African-American (Caucasian) subordinates than those in their own race using personnel records from a large corporation. At the best of our knowledge, this is the first empirical study that

studies attenuation bias in subjective evaluation that has significant consequence in terms of job allocation within an organization. Second, prior studies on subjective evaluation are mainly limited to cases in sports (Persons et al 2011, Price and Wolfers 2010); the study that relies on personnel data in a real business setting is limited to the one based on a single cross-section data (Elvira and Town 2001). Finally, quite understandably, the prior literature has focused on the effect of racial differences, which often create socio-economic divides in the society. Neglecting other characteristics that might be correlated with workers' racial backgrounds, however, may make the conclusion less definitive. We hope that our study shed light on our understanding of this behavior.

2. A Model of Evaluation Bias

We consider the three-tier organization where the management employs a supervisor who supervises a worker. The supervisor privately observes the worker's performance given by

$$y_s = a + e_s$$

where a is the worker's ability and ε is measurement error. The supervisor collects unorganized bits of information about the worker's contribution to the organization from his/her co-workers and customers and the precision of the aggregated information

depends on the amount of communication that the supervisor has with the various sources of information. We assume that $e_s \sim N(0, \sigma_s^2)$. The worker's ability is also drawn from a normal distribution $a \sim N(\bar{a}, \sigma_a^2)$. a is unknown to all parties but its distribution is public information.

Following Prendergast and Topel (1996), we assume that the supervisor's utility depends on his own pay, w_s, and on the pay of his subordinate, w_w:

$$v_s = w_s + \eta w_w$$

Here η is the intensity of the supervisor's preference for the worker. The parameter η takes both positive and negative values allowing for favoritism and discrimination. Management monitors the supervisor and penalizes biased assessment of the worker's performance. It does so by comparing the supervisor's report with its own assessment, given by

$$y_m = a + e_m$$

where $e_m \sim N(0, \sigma_m^2)$.

There are two explanations for why management delegates the authority to evaluate the worker's performance to the supervisor. First, the supervisor may have greater advantage in evaluating the worker so $\sigma_s^2 < \sigma_m^2$. Second, it may take a lot of time for management to gather performance information for individual workers. For example, y_m may be the average of the assessments of the worker's performance by

multiple supervisors over years including future ones. In this case, it is possible to have $\sigma_s^2 > \sigma_m^2$, but the need to motivate the worker in a timely manner may require the manager to delegate the right to the supervisor.

We assume that a, e_s and e_m are all uncorrelated with each other. The management set the supervisor's wage in the following way:

$$\mathrm{w}_s = \mathrm{w}_0 - 0.5\lambda(\hat{y}_s - E(\mathrm{a}|\mathrm{y}_m))^2 \qquad (1)$$

where $\hat{y}_s$ is the actual report of the supervisor's assessment and $E(\mathrm{a}|\mathrm{y}_m)$ is the best unbiased estimator of "a" conditional on y_m and can be shown to be

$$E(\mathrm{a}|\mathrm{y}_m) = \frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}\bar{\mathrm{a}} + \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\mathrm{y}_m.^{2} \qquad (2)$$

We assume that the management and the supervisor perfectly knows σ_s^2 and σ_m^2 but η is a private information of the supervisor. By this pay scheme, the management penalizes the supervisor when the supervisor reports his subordinate's evaluation different from the management's. Therefore, the supervisor pays costs for discriminating or favoring his subordinate and the parameter λ determines the size of the cost.

[2] This expression is obtained by calculating $\mathrm{E}(a|\mathrm{y_m}) = \int_{-\infty}^{\infty} a f_{a|y_m}(a|y_m)\,da = \int_{-\infty}^{\infty} a \frac{f_a(a)f_\varepsilon(y_m-a)}{\int_{-\infty}^{\infty} f_a(\acute{a})f_\varepsilon(y_m-\acute{a})d\acute{a}}da$ where $f_{a|y_m}$ is the conditional probability density function of *a* given the value of y_m, f_a is the unconditional probability density function of *a*, and f_ε is the probability density function of ε. More details of this calculation is given in the appendix.

Finally, we assume that the worker's pay depends linearly on the two pieces of information available to management: $w_w = \tau_0 + \tau_1 \hat{y}_s + \tau_2 y_m$. We treat this pay scheme as given as it is designed based on the factors (e.g. moral hazard) not considered in this model. The supervisor has an incentive to report $\hat{y}_s$ different from y_s because his subordinate's wage is partly determined by his report. The supervisor reports his subordinate's evaluation to the management considering both the cost and benefit of biasing the evaluation. It is also worth noting that the supervisor has an incentive to report attenuated evaluation when he/she does not have accurate information on the subordinate's performance to avoid his evaluation deviating from the management's evaluation.

The supervisor's problem is to solve

$$\max_{\hat{y}_s} E[\mathrm{w}_s + \eta w_w \,|\mathrm{y}_s] = \mathrm{w}_0 - 0.5\lambda E[(\hat{y}_s - E(\mathrm{a}|\mathrm{y}_m))^2|\mathrm{y}_s]$$

$$+\eta(\tau_0 + \tau_1 E[\hat{y}_s|\mathrm{y}_s] + \tau_2 \mathrm{E}[y_m|\mathrm{y}_s]).$$

For expositional purpose, let $\hat{y}_s$=E(a|y_s) + b($\eta, \mathrm{y}_s, \lambda$), where b stands for bias. The supervisor reports his subordinate's evaluation by adding bias to his best predictor of the subordinate's ability because there are two benefits for doing so. First, adding bias indulges the supervisor's taste for discrimination against (favoritism for) subordinates. Second, adding bias helps the supervisor's evaluation not standing out from the management's evaluation. The supervisor knows that he and the management do not

share the same information on the same subordinate and attempt to conform his evaluation to the management's. Substituting $\hat{y}_s$=E(a|y_s) + b(η, y_s, λ) into the objective function changes the problem to the choice of reporting bias as:

$$\max_{b} E[w_s + \eta w_w \,|y_s]$$

$$= w_0 - 0.5\lambda E[(E(a|y_s) - E(a|y_m))^2 + 2b(E(a|y_s) - E(a|y_m)) + b^2|y_s] + \eta(\tau_0 + \tau_1 E[y_s + b|y_s] + \tau_2 E(a|y_s))$$

$$= w_0 - 0.5\lambda\left[\frac{\sigma_a^4\sigma_m^4}{(\sigma_a^2+\sigma_m^2)^2(\sigma_a^2+\sigma_s^2)^2}(y_s-\bar{a})^2 + \frac{\sigma_a^4(\sigma_a^2\sigma_s^2+\sigma_a^2\sigma_m^2+\sigma_s^2\sigma_m^2)}{(\sigma_a^2+\sigma_m^2)^2(\sigma_a^2+\sigma_s^2)} + \frac{2\sigma_a^2\sigma_m^2}{(\sigma_a^2+\sigma_m^2)(\sigma_a^2+\sigma_s^2)}(y_s-\bar{a})b + b^2\right] + \eta[\tau_0 + \tau_1(y_s+b) + \tau_2\left(\frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}\bar{a} + \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}y_s\right)]$$

The first order condition of this optimization problem implies the optimal bias as:

$$b = \frac{\eta\tau_1}{\lambda} - \frac{\sigma_a^2\sigma_m^2}{(\sigma_a^2+\sigma_m^2)(\sigma_a^2+\sigma_s^2)}(y_s-\bar{a}) = \frac{\eta\tau_1}{\lambda} - \frac{\sigma_m^2/\sigma_a^2}{(1+\sigma_m^2/\sigma_a^2)(1+\sigma_s^2/\sigma_a^2)}(y_s-\bar{a})$$

The first term is the bias arising from discrimination/favoritism; the larger the benefit of giving biased evaluation (large η in absolute value), the larger the degree of the bias, while the larger the penalty of giving biased evaluation (large λ), the smaller the degree of bias. The second term expresses the bias in the form of attenuation; it takes negative value when the subordinate performs better than the average and takes positive value when the subordinate performs worse than the average in the supervisor's perception. The attenuation arises from the supervisor's desire to avoid penalty imposed

on his/her biased assessment (Equation 1). This attenuation bias is smaller when the supervisor does not have precise information about the subordinate's performance (large σ_s^2/σ_a^2) because his unbiased predictor of a, $\mathrm{E}(a|\mathrm{y_s})$, is already sufficient close to $\bar{a}$ thus he does not add intentional compression. When the management also has limited access to additional information about the worker's performance (i.e. large σ_m^2/σ_a^2), the attenuation bias gets larger because failing to set $\hat{y}_s$ close to $\mathrm{E}[y_m|\mathrm{y}_s]$ may result in huge penalty.

To obtain the prediction on the subjective performance evaluation reported by the supervisor, we substitute the optimal bias expression into $\hat{y}_s$=$\mathrm{E(a|y}_s) + \mathrm{b}(\eta, \mathrm{y}_s, \lambda)$ and obtain the following proposition.

Proposition 1

$$\begin{aligned}\hat{y}_s &= \mathrm{E}(a|\mathrm{y}_s) + \frac{\eta\tau_1}{\lambda} - \frac{\sigma_a^2\sigma_m^2}{(\sigma_a^2+\sigma_m^2)(\sigma_a^2+\sigma_s^2)}(\mathrm{y}_s - \bar{a}) \\ &= \bar{a} + \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\frac{\sigma_a^2}{\sigma_a^2+\sigma_s^2}(\mathrm{y}_s - \bar{a}) + \frac{\eta\tau_1}{\lambda} \\ &= \mathrm{y}_s + \frac{\eta\tau_1}{\lambda} - (1 - \frac{1}{1+\sigma_m^2/\sigma_a^2}\frac{1}{1+\sigma_s^2/\sigma_a^2})(\mathrm{y}_s - \bar{a})\end{aligned}$$

Formal proof is in the appendix.

The final line of the equation renders a useful empirical prediction on the evaluation the supervisor gives. The first prediction is regarding to the mean-shifting bias in the evaluation arising from the second term of the expression. If the supervisor favors the subordinate belonging to the same demographic group exhibiting *endophilia*

(preference for similar type) or he discriminates against the subordinate belonging to the different demographic groups exhibiting *exophobia* (discrimination against different type), the subordinate belonging to the different demographic groups from the supervisor receives lower subjective performance evaluation. It is worth noting that this bias is not necessarily caused by taste-based favoritism or discrimination (Becker 1957) but could be caused by the high productivity due to easier communication and coordination between the two in the same group (Lang 1986).

The second prediction is regarding to the attenuation bias in the evaluation arising from the third term of the expression. There is no attenuation bias, if both the manager and the supervisor observe the output of the subordinate perfectly, that is $\frac{\sigma_m^2}{\sigma_a^2} = \frac{\sigma_s^2}{\sigma_a^2} = 0$. On the contrary, significant uncertainty on the subordinate's ability either for the manager or the supervisor results in the larger attenuation bias. In the extreme case that either $\frac{\sigma_m^2}{\sigma_a^2}$ or $\frac{\sigma_s^2}{\sigma_a^2}$ goes to infinity, the supervisor's evaluation does not depend on his observation y_s but depends on the average ability $\bar{a}$: the case of complete attenuation. A repeated observation of a subordinate's performance on a specific position helps reducing both the supervisor's and manager's measurement error and alleviating the attenuation bias. A supervisor with less information sharing with a subordinate, that is large $\frac{\sigma_s^2}{\sigma_a^2}$, accordingly results in attenuated evaluation, echoing the implication from the language theory of discrimination by Lang (1984).

Here, we summarize the empirical implications from the model:

1. Supervisors give more candid evaluation of their subordinates as the latter accumulate longer job experience in the current workgroup.
2. When a supervisor and a subordinate belong to different social categories, thus have different experience or belong to different information networks, the supervisor gives more attenuated evaluation of the subordinate.

3. Data

We use personnel records from a large Japanese manufacturing company. We have the supervisor-worker matched information from 2006 to 2013. The supervisor information is not available for all workers partly because evaluation rating is optional for production workers and whether it is conducted or not is discretion of the management of each plant. They are also missing for some of the workers who are new (within one year), taking leaves, or transferred to subsidiaries.

The company assigns job grade to each worker as the career progression is drawn in Figure 1. Typical evaluators for regular workers hold the G4 job grade. Therefore, we restrict our analysis sample to those evaluated by the managers with the G4-G1 job grades. G4 is the lowest and G1 is the highest managerial rank. After dropping the

observations that do not satisfy this requirement, the total number of observations is 36,383.

Job grades that are assigned to the employees enable us to identify management-track professionals and non-professionals, the latter of which may include production workers and administrative assistants. As you see in Figure 1, all employees at the entry level, including both college graduates and high school graduates, start at the J1 grade. Management track white-collar (college graduate) workers quickly move up to the SA level, while non-professional (non-college graduate) workers move up the ladder for non-professional workers, J-labeled grades, very slowly.

Workers are ranked as C, B, A3, A2, A1, or S where C and S are the lowest and the highest, respectively. Table 1 tabulates the distribution of the evaluation grades. As you see in Table 1, the evaluation scales was changed in 2008 for managers and in 2010 for workers: A1, A2 and A3 were consolidated into A, and the standards for S and B were also adjusted accordingly.

As dependent variables, we created two evaluation grade dummies with *A1&over* indicating A1 and better grades (only S after the consolidation), and *A3&Below* indicating A3 and lower ones (B and lower grades after the consolidation). Given that A2 (or A after the consolidation) accounts for 60-80% of the total observations, using both indicator variables allows us to evaluate the impact of the subordinate and

supervisor's characteristics and the latter's learning of the former's ability on the variance of the grade.

Explanatory variables indicating the supervisor's and subordinate's characteristics are used to identify possible sources of evaluation bias. We first include the subordinate's length of tenure at the current position to capture the learning speed of worker productivity by the supervisor and the management. As the subordinate stays in the current position, both the supervisor and the management repeatedly observe the subordinate's output and presumably obtain more accurate measure of the subordinate's true ability through the law of large numbers. As standard literature on Bayesian learning indicates the accuracy of true ability improves but at decreasing rate as time passes.

There are two reasons why employer learning may not accumulate continuously across different positions. First, part of this learning should be specific to particular skills required for the position thus may lose some value on the next job assignment because new jobs may require different skills. In this case, learning may be publicly shared within the organization but new learning curves start every time workers are assigned to other positions that require new skills. Second, learning of the ability information is at least partly private because nobody fully trust the assessment made by

others especially for the ability that is not proven by the performance output directly observable to others.

We capture the effects of the differences in demographic characteristics between the subordinate and the supervisor by the interaction term of or the difference in the demographic variables of each of them. The demographic characteristics include age, gender, education, marital status, and parental experience We in addition create a dummy variable that takes value one when the alma maters of the subordinate and the supervisor coincide to see if a link within a school network has any effect on subjective evaluation.

The descriptive statistics are summarized in Table 2.

4. Empirical Strategy

In this section, we first examine the existence of both mean-shifting and variance-shifting evaluation bias due to the supervisor's preference toward the subordinate and the inaccurate information on the subordinate's ability to test the theoretical predictions summarized in Proposition 1.

We estimate the subordinate's fixed effect model to allow for unobserved ability heterogeneity of the subordinate exploiting the panel feature of our personnel data set. The fixed effects model is specified as follows for worker *i*, supervisor *j*, and year t, respectively:

$$y_{ijkt} = \boldsymbol{X_{ijt}\beta} + +\bar{\boldsymbol{X}}_{\boldsymbol{kt}}\boldsymbol{\delta} + \boldsymbol{Z_{ijt}\gamma} + c_i + d_t + f_{K(k)} + u_{ij} \quad (1)$$

where y_{ijkt} is the binary variable taking one if the evaluation given to worker *i* who is working with supervisor *j* in workgroup *k* in year *t* is *A1&over* or *A3&Below*, $\boldsymbol{X_{ijt}}$ is a vector of control variables including worker's tenure, current workgroup tenure, supervisor's job tenure, marital status, the interaction between the worker's gender and marital status dummies, the interaction between gender and the number of children in logarithm, and job grade dummies. The job grade dummy variables capture the difference of evaluation criteria across job ranks. The vector $\boldsymbol{X_{ijt}}$ does not include time-invariant variables such as gender and education because those are absorbed in the fixed effects.

$\bar{\boldsymbol{X}}_{kt}$ is a vector of workgroup characteristic such as average tenure, average current workgroup tenure, average number of schooling, and ratios of female workers and married workers. Inclusion of workgroup average characteristics as explanatory variables helps capture the workgroup heterogeneity that could be correlated with the variables in $\boldsymbol{X_{ijt}}$.

$\boldsymbol{Z_{ijt}}$ is a vector of social category match variables of worker *i* and supervisor *j* who form the pair in year *t* indicating how different or similar the supervisor and the worker are in demographic characteristics including family structure, gender, education and age. More specifically, for family structure, we have three indicator variables, *have*

*child*no child*, meaning that the supervisor has a child and the worker has no children, and *no child*have child* and *no child*no child* defined similarly. For gender, we have two indicator variables, *male*female*, showing that the supervisor is male and the subordinate is female, and *female*male* defined similarly. Note that *male*male* is our reference group. *female*female* is dropped in the fixed effect model because of the linear relationship *female*female = female - male*female* where *female* is time-invariant. For education, we have two indicator variables, *supervisor>subordinate*, meaning that the supervisor has higher education that the worker, and *supervisor<subordinate* defined similarly. The reference group is the case when the supervisor and the worker has the same level of education. For age, we have two variables: positive age difference is the age of the supervisor minus the age of the subordinate when it is positive and negative age difference is defined as the absolute value of the same age difference when it is negative. The vector $\boldsymbol{Z_{ijt}}$ also includes *same school dummy*, the indicator of the case when the worker and the supervisor went to the same college.

The variable c_i is the worker fixed effects, d_t is the year fixed effects, $f_{K(k)}$ is the fixed effects of division *K* that includes workgroup *k*, and u_{ij} is the error term uncorrelated with the rest of the terms. Note that the division effect is included because evaluation distribution may differ across different divisions and, given that a substantial

portion of workers move between divisions, this effect can be still identified in the model with worker fixed effects.

As in the Persons et al. (2011), readers might see it necessary to control for the supervisor's fixed effect[3]. However, this company requires all evaluators to keep the average at A2 and our null hypothesis that supervisor effects are all zero cannot be rejected.[4] Thus, we have decided not to control for the supervisor's fixed effect.

5. Empirical Results

We performed the full specification regressions separately for non-managerial workers and managers (i.e. middle managers are evaluated by senior managers) because they exhibit quite different bias pattern. The regression results for *A1&Over* are in Columns 1 and 3 of Table 3 and those for A3& Below are in Columns 2 and 4.

5.1 Results for non-managerial workers

An increase in the worker's current workgroup tenure is expected to raise the probability of receiving good evaluations because the workplace tenure captures the accumulation of workplace specific-skill or deepening of private learning of the

[3] Persons controlled not only pitcher's (worker's) fixed effect but also umpire's (evaluator's) fixed effect to capture the evaluation bias.
[4] Numerical representation of S-C grades were not revealed to the researchers.

worker's ability by the supervisor. On the contrary, accumulation of the workplace tenure either decrease or increase the probability of receiving bad evaluation; it decreases the probability due to the workplace specific skill accumulation but increases the probability due to the supervisor's learning about the worker's ability. In sum, longer workplace tenure unambiguously increases the probability to receive good evaluation it either increase or decrease the probability to receive bad evaluation. The findings for non-managerial workers indicate that those with longer current workgroup tenure are more likely to receive both good and bad evaluations; additional year of current workplace tenure increases the probability of receiving good evaluation by 1.5 percentage points and bad evaluation by 1.2 percentage points. These findings are consistent with the supervisors' private learning of subordinates' ability on the job.

There are some other notable findings in the table although they are not our primary interest in this study. First, the coefficient of supervisor's position tenure is negative for *A1&Over* in column 1 suggesting that supervisors are more likely to give good evaluation grades to high performers when they have shorter experience on the position. Inexperienced managers may be easily impressed.

Second, we observe clear marriage premium for men and marriage penalty for women in the sample of non-managerial workers. In column 1, the coefficient of *marriage* is significantly positive at the 5% level but the coefficient of *female*marriage*

is significantly negative and three times greater than that of *marriage*; married male workers are 2.9 percentage points more likely to receive good evaluation than single male workers whereas married female workers are 6.0 percentage points less likely to receive good evaluation than single female workers on average. We in addition observe maternity penalty for women. The coefficient of *Female*ln(number of children)* is negative for *A1&Over*.

Thirdly, the tenure effect, which was expected to capture public learning of worker ability within the organization and the accumulation of general skill shows that workers with longer firm tenure are less likely to receive good evaluation and more likely to receive low evaluation. The results might be counterintuitive at the first but the findings can be explained by endogenous job assignment—high-performers get promoted to a higher-level position where evaluation standard is higher—and attrition—capable workers tend to get promoted to the managerial positions thus dropped out of this subsample. As a result a workers who stay longer in the non-managerial positions are less likely to receive good evaluation and more likely to receive bad evaluation: a phenomenon called the Peter principle—workers are promoted to their level of incompetence. Overall, the effects of firm tenure on evaluation are difficult to interpret in a causal sense because of the endogeneity of job assignment and the sample selection issue.

For match variables, our variables of interest, we interpret negative coefficients for both *A1&Over* and *A3&Below* as a possible indication of attenuation bias when at least one of the coefficients is statistically significant. We have three interesting results. First, when the supervisor has no child and the worker has any children, evaluation tends to be attenuated. It seems that when the supervisor has no experience in parenting and the subordinate has more time constraint due to parenting, the former has a trouble accurately evaluating the latter's contribution compared with the supervisors who have parenting experience.

Second, the coefficients of *supervisor's education>subordinate's education* are negative for both *A1&Over* and *A3&Below* although the latter is statistically and economically insignificant. It seems to suggest that more educated supervisors tend to give more attenuated evaluation to less educated workers. Note that college-graduate employees are management-track professionals and have different career tracks than those with lower education. Therefore, when college-graduate managers supervise blue-collar workers or administrative assistants, the former has never had the same working experience as their subordinates. In contrast, when blue-collar workers or administrative assistants get promoted to become supervisors (although they are relatively rare cases), they know the contents of tasks in details. Therefore, it is very

likely that the workers' performance is more accurately measured by those who move up from the nonprofessional career tracks.

Thirdly, the coefficients of *negative age difference* are negative for both *A1&Over* and *A3&Below* although the former is statistically and economically insignificant. This implies that the evaluation is attenuated when the worker is older than his/her supervisor: a finding corroborating with the Proposition 1 because communicating with senior subordinate is arguably difficult for junior supervisor in the Japanese culture that encourages people to admire older people under the influence of Confucianism.

We did not find any evidence of mean-shifting bias or attenuation bias associated with gender differences. Note, however, that according to the coefficients of *male*female* for *A1&Over* (column 1) and *A3&Below* (column 2), male managers are 11.1 percentage point less likely to give good evaluation grades and 20.5 percentage point more likely to give bad evaluation grades to female workers than female managers after accounting for unobservable ability with worker fixed effects, although they are not statistically significant. Lack of statistical significance may simply reflect the fact that we have very limited number of female managers (roughly 1%).

5.2 Results for managerial workers

The results for managerial workers reported in third and fourth columns show that a manager with longer current workgroup tenure is more likely to receive good (A1 and over) evaluation. This could be due to the supervisors' learning or the accumulation of relationship or job specific-skill. Contrary to the results among non-managerial workers, a manager with longer workgroup tenure is not likely to receive bad evaluation. There are several possible reasons for this finding. Firstly, the private learning of manager's ability by his supervisor is less important among managers because manager's skill could be more general and workgroup specific learning is less important. Secondly, perhaps more importantly, the endogeneity of job assignment and attritions of managers can cause a both endogeneity bias and sample selection bias. For example, good managers tend to get promoted in a shorter period of time and do not stack with the current work group for long whereas a bad manager who tends to receive bad evaluation tends to get demoted or transferred to other workplaces, thus he tends to have shorter tenure at the current workplace. Supervisors with longer position tenure are more likely to give bad evaluation of his subordinate manager: a result consistent with the finding for non-managerial workers that new supervisors tend to give lenient evaluation of subordinates. A manager with longer firm tenure is less likely to receive bad evaluation perhaps because of the human capital accumulation or only those who do not receive bad evaluation can survive as managers.

Almost none of match variables are statistically significant in the estimation using managers as the analysis sample. An exception is that if the supervisor and the subordinate manager graduated from the same school, the subordinate manager is about 5 percentage points less likely to receive bad evaluation. Combined with the finding that the same case is 1.7 percentage points more likely to result in good evaluation, while not statistically significant, there could be favoritisms among the same school graduates in case of managers.

5.3 Gender difference

Given that almost all supervisors are male, Proposition 1 may suggest that there should be attenuation bias for women. We cannot simply estimate the gender effect on the distribution of evaluation grades because gender may be correlated with unobservable ability. When we use fixed effect models to account for unobservable ability, any time-invariant variables including gender cannot be included.

As an alternative, we evaluate the gender gap in the speed of employer learning by estimating the model separately between men and women. Table 4 shows the result for the sample of non-managerial employees only because there are very few female managers. The baseline model specification is the same as in Table 3 except that we do not carry match variables $\boldsymbol{Z_{ijt}}$ in equation (1) and any interaction terms with *female* are

dropped. Column 1 and 3 are baseline models while tenure and its square are dropped in column 2 and 4 because tenure does not seem to be correlated with productivity once job levels are controlled for but their presence may impose bias on current workgroup tenure.

As Table 4 shows, the coefficients of *current workgroup tenure* are slightly smaller for women than for men implying that ability of women may be more slowly revealed to the supervisor than men. The difference is illustrated in Figure 2 where the coefficients in columns 2 and 4 are used to calculate the effects. As long as men and women are assigned to the same job, slower employer learning for women will lead to more attenuated evaluation for them.[5]

6. Conclusion and Extension

We set up a behavioral model of the supervisor who may have discriminatory taste and does not have accurate information on the subordinate ability. The model predicts that the discriminatory taste potentially causes mean-shifting bias and the aversion for the supervisor's evaluation standing out from the management's evaluation

[5] In addition to our earlier discussion that a supervisor may have disadvantage in acquiring ability/performance information of his subordinate who belongs to a different social identity group, there could be additional reason behind this possible slower employer learning for women. We heard some anecdotes from practitioners that managers often assign more challenging tasks to men instead of women even if their expected ability is the same because rigorous training which also require time-consuming attention of managers may not pay off if newly hired women quit or because managers believe such training may induce less committed women to quit.

causes attenuation bias in the subjective performance evaluation. Using personnel records from a large Japanese manufacturing company, we find that supervisors tend to give more candid evaluation as they accumulate more performance information of their subordinates over time. We also find a suggestive evidence that sharing a similar family structure (i.e. having any children), the same educational attainment and age by a supervisor and his subordinate tends to result in candid evaluation implying that different demographic backgrounds between the supervisor and the worker may make the former disadvantaged in learning the latter's ability thus potentially leading to attenuation biases in subjective performance evaluation.

We did not find any clear evidence of taste-based discrimination or "own-group effect" in the company. Yet, we find some suggestive evidence of gender gap in employer learning. The supervisor's learning of the ability of female workers may be slower than male workers. If this is further confirmed by additional evidence, the finding will imply more attenuated evaluation for women than men.

There are two questions we can explore as future research.

First, the speed of employer learning may also vary across education levels or job categories. Learning of worker ability may be faster for production workers and administrative assistants than more professional occupations. Furthermore, although we control for job grades of workers in our analyses, we may still need to account for

differences in jobs because job assignment is not random. If more women are sorted into “specialists” jobs where outstanding performance or poor performance is less conspicuous, learning of their ability may be slower than those in jobs where performance is more easily measured such as sales.

Second, we might be able to explore for evaluating consequences of biases such as whether biased evaluation tends to end with transfers or quits of workers or whether supervisors who tend to make biased evaluation are punished or not. Our dataset allows us to pursue those extensions but such topics are beyond the theme of this study.

Appendix.

Lemma $E(\mathrm{a}|\mathrm{y}_m) = \frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}\bar{\mathrm{a}} + \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\mathrm{y}_m$, $E(\mathrm{a}|\mathrm{y}_s) = \frac{\sigma_s^2}{\sigma_a^2+\sigma_s^2}\bar{\mathrm{a}} + \frac{\sigma_a^2}{\sigma_a^2+\sigma_s^2}\mathrm{y}_s$.

Proof: We will show the proof for y_m because the two equations are identical. This expression is obtained by calculating

$$\mathrm{E}(a|\mathrm{y}_\mathrm{m}) = \int_{-\infty}^{\infty} a f_{a|y_m}(a|y_m)\, da = \int_{-\infty}^{\infty} a \frac{f_a(a) f_\varepsilon(y_m - a)}{\int_{-\infty}^{\infty} f_a(\acute{a}) f_\varepsilon(y_m - \acute{a}) d\acute{a}} da \qquad \text{(A1)}$$

where $f_{a|y_m}$ is the conditional probability density function of *a* given the value of y_m, f_a is the unconditional probability density function of *a*, and f_ε is the probability density function of ε. Now,

$$f_a(a) f_\varepsilon(y_m - a) = \frac{1}{\sqrt{2\pi\sigma_a^2}} \exp\left[-\frac{(a-\bar{a})^2}{2\sigma_a^2}\right] \frac{1}{\sqrt{2\pi\sigma_m^2}} \exp\left[-\frac{(y_m - a)^2}{2\sigma_m^2}\right]$$

$$= \frac{1}{\sqrt{2\pi(\sigma_a^2+\sigma_m^2)}} \exp\left[-\frac{(y_m-\bar{a})^2}{2(\sigma_a^2+\sigma_m^2)}\right] \frac{1}{\sqrt{2\pi\frac{\sigma_a^2\sigma_m^2}{\sigma_a^2+\sigma_m^2}}} \exp\left[-\frac{1}{2\frac{\sigma_a^2\sigma_m^2}{\sigma_a^2+\sigma_m^2}}\left(a - \frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}\bar{\mathrm{a}} - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\mathrm{y}_m\right)^2\right].$$ Then, by substituting this into (A1), we obtain

$$\mathrm{E}(a|\mathrm{y}_\mathrm{m}) = \int_{-\infty}^{\infty} a \frac{1}{\sqrt{2\pi\frac{\sigma_a^2\sigma_m^2}{\sigma_a^2+\sigma_m^2}}} \exp\left[-\frac{1}{2\frac{\sigma_a^2\sigma_m^2}{\sigma_a^2+\sigma_m^2}}\left(a - \frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}\bar{\mathrm{a}} - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\mathrm{y}_m\right)^2\right] da.$$ This concludes the proof.

Proof of Proposition 1

First, from the above lemma,

$$E(\mathrm{a}|\mathrm{y}_s) - E(\mathrm{a}|\mathrm{y}_m) = \frac{\sigma_a^2}{\sigma_a^2+\sigma_s^2}(\mathrm{y}_s - \bar{\mathrm{a}}) - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}(\mathrm{y}_m - \bar{\mathrm{a}}).$$

Then,

$$\mathrm{E}[E(\mathrm{a}|\mathrm{y}_s) - E(\mathrm{a}|\mathrm{y}_m)|\mathrm{y}_s] = \frac{\sigma_a^2}{\sigma_a^2+\sigma_s^2}(\mathrm{y}_s - \bar{\mathrm{a}}) - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}(\mathrm{E}(\mathrm{y}_m|\mathrm{y}_s) - \bar{\mathrm{a}})$$

$$= \frac{\sigma_a^2}{\sigma_a^2+\sigma_s^2}(\mathrm{y}_s - \bar{\mathrm{a}}) - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\left(\frac{\sigma_s^2}{\sigma_a^2+\sigma_s^2}\bar{\mathrm{a}} + \frac{\sigma_a^2}{\sigma_a^2+\sigma_s^2}\mathrm{y}_s - \bar{\mathrm{a}}\right)$$

$$= \frac{\sigma_a^2\sigma_m^2}{(\sigma_a^2+\sigma_m^2)(\sigma_a^2+\sigma_s^2)}(\mathrm{y}_s - \bar{\mathrm{a}})$$

where the first equality is obtained from $\mathrm{E}(\mathrm{y}_m|\mathrm{y}_s) = \mathrm{E}(a|\mathrm{y}_s)$ and the above lemma. We further calculate

$$\mathrm{E}[\big(E(\mathrm{a}|\mathrm{y}_s) - E(\mathrm{a}|\mathrm{y}_m)\big)^2|\mathrm{y}_s] = \mathrm{E}[\left(E(\mathrm{a}|\mathrm{y}_s) - \frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}\bar{\mathrm{a}} - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}(\mathrm{a}+\varepsilon_m)\right)^2|\mathrm{y}_s]$$

$$= \mathrm{E}[\left(\frac{\sigma_m^2}{\sigma_a^2+\sigma_m^2}(E(\mathrm{a}|\mathrm{y}_s) - \bar{\mathrm{a}}) - \frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}(\mathrm{a} - E(\mathrm{a}|\mathrm{y}_s) + \varepsilon_m)\right)^2|\mathrm{y}_s]$$

Since $\mathrm{a} - E(\mathrm{a}|\mathrm{y}_s)$ and ε_m are independent and their conditional means are zero,

$$\mathrm{E}[\big(E(\mathrm{a}|\mathrm{y}_s) - E(\mathrm{a}|\mathrm{y}_m)\big)^2|\mathrm{y}_s]$$

$$= \frac{\sigma_a^4\sigma_m^4}{(\sigma_a^2+\sigma_m^2)^2(\sigma_a^2+\sigma_s^2)^2}(\mathrm{y}_s - \bar{\mathrm{a}})^2 + \left(\frac{\sigma_a^2}{\sigma_a^2+\sigma_m^2}\right)^2(V(\mathrm{a}|\mathrm{y}_s) + \sigma_m^2) =$$

$$= \frac{\sigma_a^4\sigma_m^4}{(\sigma_a^2+\sigma_m^2)^2(\sigma_a^2+\sigma_s^2)^2}(\mathrm{y}_s - \bar{\mathrm{a}})^2 + \frac{\sigma_a^4(\sigma_a^2\sigma_s^2 + \sigma_a^2\sigma_m^2 + \sigma_s^2\sigma_m^2)}{(\sigma_a^2+\sigma_m^2)^2(\sigma_a^2+\sigma_s^2)}$$

Taking a derivative to derive the first-order condition is straight-forward. This concludes the proof.

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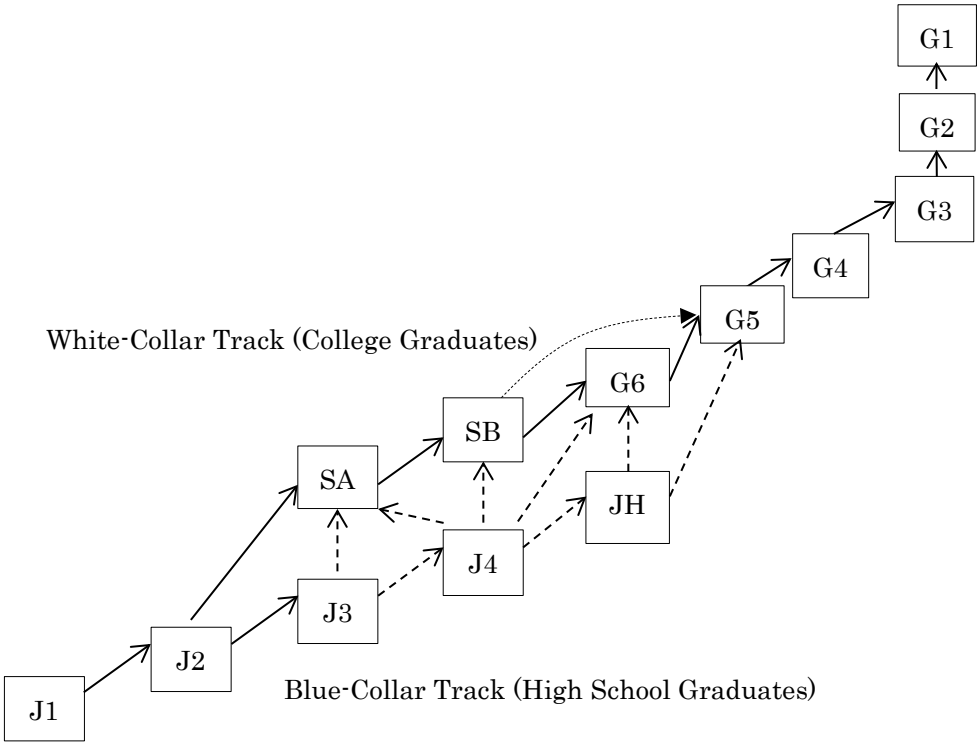
Figure 1 Promotion Path Chart



Note: The solid line indicates promotion patterns that a majority of people in the job grade eventually follow while the dotted line shows tracks that only a minority of people can proceed.

Table 1. Distribution of Evaluation Grades

Non-managerial Workers

	2006	2007	2008	2009	2010	2011	2012	2013
S	1.9%	2.1%	2.1%	2.3%	13.1%	14.0%	15.8%	14.3%
A1	19.7%	17.9%	15.2%	16.0%				
A2	62.3%	65.8%	70.6%	67.3%	80.5%	78.9%	75.6%	77.0%
A3	13.6%	11.2%	9.5%	11.3%				
B	2.0%	2.6%	2.2%	2.5%	5.9%	6.5%	7.4%	7.4%
C	0.6%	0.4%	0.4%	0.7%	0.5%	0.5%	1.3%	1.2%

Managers

	2006	2007	2008	2009	2010	2011	2012	2013
S	2.8%	2.3%	11.7%	11.2%	14.2%	12.7%	11.7%	12.4%
A1	23.4%	19.9%						
A2	55.9%	62.1%	82.6%	78.7%	78.1%	79.9%	76.3%	74.5%
A3	15.2%	13.0%						
B	2.2%	2.2%	5.3%	9.4%	7.0%	6.6%	10.3%	11.6%
C	0.4%	0.4%	0.4%	0.8%	0.7%	0.8%	1.7%	1.5%

Note: A1-A3 are consolidated into new A grade (recorded in the column for A2) in 2008 for managers and in 2010 for non-managerial regular workers.

Table 2 Descriptive statistics

	Mean	Std.	Min	Max
Age	41.2	10.0	19	60
Tenure	16.14	11.57	0	44
Current Work Group Tenure	2.8328	2.1345	0	9
Supervisor's Position Tenure	1.1016	1.3859	0	7
ln(Number of Children+1)	0.502	0.529	0	2.56
	Percentage			
Female	10.2			
Married	73.0			
Education				
High School	40.85			
Technological College	3.27			
Two-year College	7.13			
College: Undergraduate	22.33			
College: MA	16.54			
College: Ph.D	1.33			
Evaluation				
A1&Over	15.8			
A3&Below	10.6			

Table 3. Determination of evaluation

	Non-managerial Workers				Managers			
	Above A2		Below A2		Above A2		Below A2	
Current workgroup tenure	0.0146	***	0.0118	***	0.0117	**	-0.0009	
	(0.0045)		(0.0038)		(0.0052)		(0.0045)	
Current workgroup tenure^2	-0.0010	**	0.0001		-0.0006		0.0002	
	(0.0005)		(0.0003)		(0.0005)		(0.0004)	
Supervisor's tenure on the current position	-0.0041	***	0.0021		-0.0020		0.0038	**
	(0.0015)		(0.0013)		(0.0021)		(0.0018)	
Married	0.0288	**	-0.0075		-0.0360		0.0578	
	(0.0127)		(0.0107)		(0.0364)		(0.0355)	
Female*Married	-0.0890	**	0.0347		0.0601		-0.0130	
	(0.0371)		(0.0301)		(0.0699)		(0.2688)	
ln(number of children)	0.0124		0.0138		-0.0268		0.0516	
	(0.0289)		(0.0233)		(0.0408)		(0.0339)	
Female*ln(number of children)	-0.1256	**	-0.0045		-0.1455		0.2983	**
	(0.0505)		(0.0457)		(0.1160)		(0.1395)	
Tenure	-0.0200	***	0.1175	***	-0.0081		-0.0274	***
	(0.0055)		(0.0053)		(0.0065)		(0.0061)	
Tenure^2	-0.0003	***	-0.0001		-0.0002	*	0.0004	***
	(0.0001)		(0.0001)		(0.0001)		(0.0001)	
Have child ´ No child	-0.0090		0.0117		-0.0280		0.0436	
	(0.0242)		(0.0198)		(0.0346)		(0.0303)	
No child ´ Have child	-0.0247	**	-0.0118		0.0196	*	-0.0089	
	(0.0106)		(0.0076)		(0.0117)		(0.0092)	
No child ´ No child	-0.0145		0.0069		-0.0017		0.0223	
	(0.0255)		(0.0207)		(0.0343)		(0.0299)	
Male ´ Female	-0.1114		0.2045		0.1255		-0.0839	
	(0.0960)		(0.1352)		(0.0885)		(0.0880)	
Female ´ Male	-0.0813		-0.0616		0.0141		0.0318	
	(0.0890)		(0.1704)		(0.0512)		(0.0701)	
Supervisor > subordinates	-0.0304	***	-0.0025		0.0083		-0.0056	
	(0.0106)		(0.0089)		(0.0139)		(0.0119)	
Supervisor < subordinates	0.0042		-0.0034		0.0048		-0.0037	
	(0.0124)		(0.0101)		(0.0140)		(0.0114)	
Same school dummy	-0.0282		-0.0101		0.0168		-0.0475	***
	(0.0306)		(0.0218)		(0.0222)		(0.0164)	
Positive age difference	0.0027	***	-0.0005		-0.0008		-0.0003	
	(0.0009)		(0.0008)		(0.0015)		(0.0011)	
Negative age difference	-0.0007		-0.0054	***	0.0024		-0.0002	
	(0.0016)		(0.0018)		(0.0022)		(0.0029)	
Work-group characteristics	Yes				No			
Division Fixed Effect	Yes				Yes			
# of observations	26035		26035		11707		11707	
R^2 (within)	0.0237		0.0234		0.0565		0.0504	

Note: Job grade and fiscal year dummy variables are included. Bootstrapped standard errors are used to account for heteroecedasticity.

Table 4. Are learning speeds different between men and women?

	Non-managerial Employees															
	Men								Women							
	A1&Over				*A3&Below*				*A1&Over*				*A3&Below*			
Current Work Group Tenure	0.0165	***	0.0210	***	0.0162	***	0.0179	***	0.0140		0.0157		0.0053	*	0.0058	
	(0.0057)		(0.0056)		(0.0057)		(0.0056)		(0.0096)		(0.0097)		(0.0066)		(0.0066)	
Current Work Group Tenure^2	-0.0013	*	-0.0016	**	-0.0006		-0.0007		-0.0010		-0.0011		0.0005		0.0005	
	(0.0007)		(0.0007)		(0.0007)		(0.0007)		(0.0007)		(0.0007)		(0.0003)		(0.0003)	
Supervisor CWG Tenure	-0.0040	**	-0.0041	**	0.0025	*	0.0025	*	0.0027		0.0027		-0.0002		-0.0002	
	(0.0016)		(0.0016)		(0.0015)		(0.0015)		(0.0042)		(0.0042)		(0.0021)		(0.0021)	
Marriage	0.0321	**	0.0366	***	-0.0113		-0.0095		-0.0655	*	-0.0549		0.0256		0.0287	
	(0.0127)		(0.0126)		(0.0106)		(0.0105)		(0.0369)		(0.0365)		(0.0300)		(0.0290)	
ln(# of Children)	0.0156		0.0307	**	0.0029		0.0087		-0.1185	**	-0.1020	**	0.0208		0.0257	
	(0.0158)		(0.0154)		(0.0119)		(0.0118)		(0.0518)		(0.0513)		(0.0389)		(0.0391)	
Tenure	-0.0174	***			0.1270	***			-0.0046				-0.0091			
	(0.0051)				(0.0045)				(0.0140)				(0.0143)			
Tenure^2	-0.0003	***			-0.0001				-0.0003				-0.0001			
	(0.0001)				(0.0001)				(0.0002)				(0.0002)			
Work-group characteristics	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Division Fixed Effect	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
#of observations	22849		22849		22849		22849		3459		3459		3459		3459	
#of groups	4704		4704		4704		4704		779		779		779		779	

Figure 2 Gender Gap in Employer learning