
RCESR Discussion Paper Series

**Firms' Incentive Provisions:
Tournament Structure and Worker Flow**

May 2016

Ryo Kambayashi, Hitotsubashi University
Yuko Ueno, Hitotsubashi University

RCESR

The Research Center for Economic and Social Risks

Institute of Economic Research
Hitotsubashi University

2-1 Naka, Kunitachi, Tokyo, 186-8603 JAPAN
<http://risk.ier.hit-u.ac.jp/>

Firms' Incentive Provisions: Tournament Structure and Worker Flow*

Ryo Kambayashi[†]

Yuko Ueno[‡]

May 2016

Abstract

This study aims to empirically examine how establishments employ various tools, including promotion, threat of dismissal, progressive base wages, and bonuses, to motivate workers. Starting with the standard tournament model, we incorporate the link between the tournament structure and the worker separation that affects the degree of internal competition for managerial positions. By using an establishment-level panel data set, we find that the average policy of human resource management in Japan, particularly since the global financial crisis, is consistent with tournament theory. Further, there is evidence that establishments use a positive selection scheme for determining the set of candidates. The progressive base wage schedule and the smaller portion of bonus payments for employees who remain are also consistent with the selection scheme.

Keywords: Promotion tournament, internal competition, worker separation, wage progression

JEL Classification: M51, M52, J31, J63

* We thank Jed DeVaro, Richard Duhautois, Henry Farber, Anders Frederiksen, Hideshi Itoh, Takao Kato, Daiji Kawaguchi, Peter Kuhn, Hideo Owan, Heloise Petit, participants in the Conference on Tournament/Promotion at Hitotsubashi University, participants in the seminar at the Centre d'études de l'emploi, participants at RIETI, and participants at the Trans-Pacific Labor Seminar. We are grateful to Japan's Ministry of Health, Labour and Welfare for permission to use the data. We greatly acknowledge financial support from the Japan Society for the Promotion of Sciences Grants-in-Aid for Research Activity (24330074, 26380359) and from Program for Advancing Strategic International Networks to Accelerate the Circulation of Talented Researchers.

[†] Institute of Economic Research, Hitotsubashi University, 2-1 Naka, Kunitachi, Tokyo 186-8603, Japan; E-mail: kambayas@ier.hit-u.ac.jp

[‡] Institute of Economic Research, Hitotsubashi University, 2-1 Naka, Kunitachi, Tokyo 186-8603, Japan; E-mail: yu-ueno@ier.hit-u.ac.jp.

1. A Brief Literature Review and the Aim of This Study

Promotion tournament theory is one of the key insights in personnel economics literature and has been regarded as a major incentive tool for motivating employees to make effort in a modern organization. In this study we empirically consider how a promotion tournament should be linked to the other incentive tools, particularly to the selection scheme for determining the contestant pool and to payment schemes such as progressive base wages and bonuses. More specifically, we investigate whether these various incentive tools are applied to the employees complementarily or substitutively, based on the establishment-level panel data sets from Japan.

A seminal work by Lazear and Rosen (1981) initiated the literature on tournament theory by examining how the prize structure associated with promotions affects workers' incentives. Rosen (1986) extended the analysis to multi-round tournaments. Multiple steps of competition naturally introduce heterogeneity among workers, for which Meyer (1992) added the possibility of biased promotion contests. The focus of those classical tournament theories was on whether the optimal tournament prize maintained a certain level of worker effort, assuming that firms are organized based on a hierarchy with a fixed number of managerial positions. Another possible explanation for the positive wage spreads between hierarchical levels was proposed by Waldman (1984). In his market-based mechanism, because promotions serve as signals of worker ability, current employers of tournament winners must offer wage premiums to them in order to match wage offers from other employers. Recent researchers, on the other hand, have started to theoretically examine the endogenous choice of the tournament structure itself, which is inextricably linked with the firm's other incentive schemes. For example, DeVaro and Morita (2013) examined the relationship between the choice of tournament size and the scheme for selecting candidates. Similar to recent studies of tournament models, such as DeVaro and Morita (2013), this study clearly takes into account the link between tournament structure and candidate selection.

Empirically, several previous works have already discussed that, from the viewpoint of promotion tournament theory, negative selection mechanisms exist within firms. For example, Lazear (1992) found that the number of years a worker has spent in the same job negatively affects his or her real wage growth and interpreted it as the result of spending a long time in the same job making a worker more likely to be a loser in the promotion competition. Gibbs (1995) also argued that worker performance falls as job tenure increases, because the worker's hopes of winning a promotion dwindle over time. In this regard, the

study on selection mechanism in promotion is closely related to the literature on the returns to seniority in the way of Topel (1991) that found a very strong connection between job seniority and wages in a typical employment relationship. Since Topel (1991) argued that the accumulation of specific human capital is an important factor behind this employment relationship, the literature has drifted toward uncovering workers' unobserved productivity by analyzing the changes in wages among employers. However, partially because the household panel data such as the National Longitudinal Survey does not include information on the promotion structure of employers, the two areas of literature have not intersected sufficiently. Therefore, the recent extension of promotion literature can shed light on both the internal structure of wage progression and the corresponding selection scheme for promotion. This study provides empirical evidence of the combination of promotion policy and wage-tenure profile within the same establishment, which enables us to examine the selection mechanism in an indirect way.

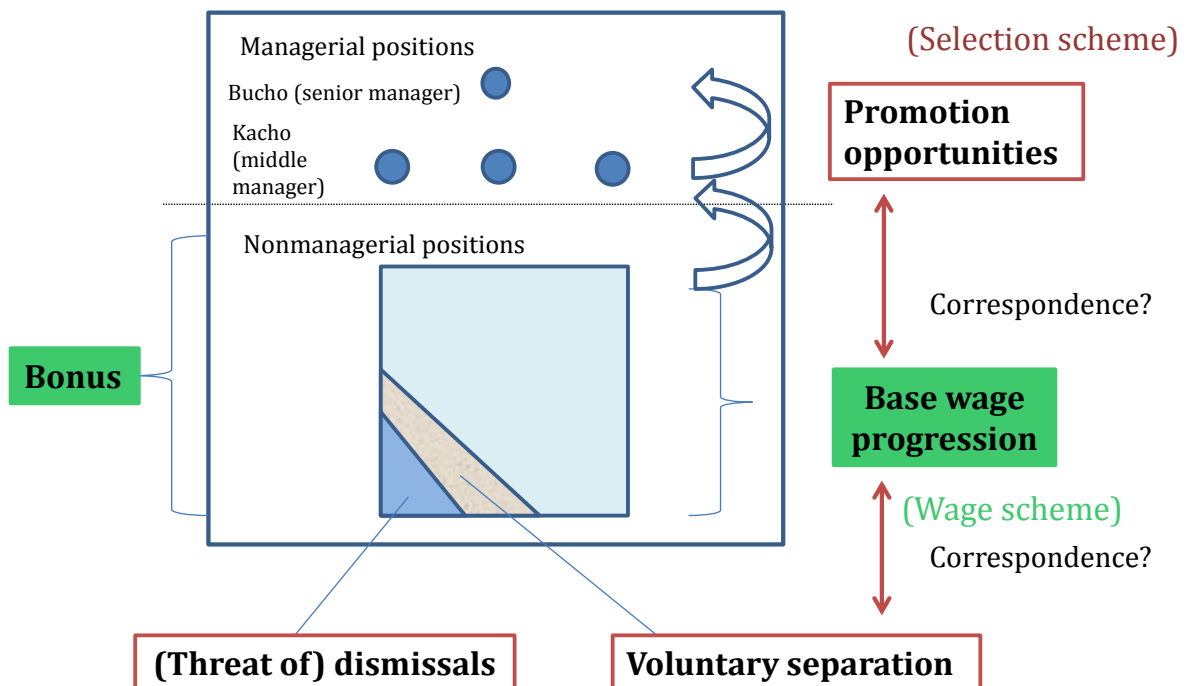
The selection scheme is not the only incentive device that firms should choose; for example, Frederiksen and Takáts (2009) showed the theoretical possibilities of the combination of selection scheme, dismissal policy, and wage scheme, given a set tournament size, and proves their complementarity and the substitutability. One of the key results that they derived from their model is that promotions and dismissals rank at the top of the incentive hierarchy, because each serves as not only an incentive scheme but also a mechanism of sorting employees and selecting candidates for promotion. Bonus payments are employed in a complementary manner to these incentives and are only included in an optimal contract when promotions and dismissals do not provide sufficient incentive. Wages are used only to make the contract acceptable to employees.

Compared with the theoretical investigations in the literature, the empirical evidence for the effect of combinations of various human resource management policies has not been examined fully. This lack exists in part because the statistical test require sufficiently large variation in management policy among establishments but the data often used in the personnel economics studies is from only one organization. In this study we will exploit the advantage of Japanese governmental data that covers various industries in the Japanese economy. In addition, combined with multiple individuals in the same establishment, this data set includes both cross-sectional and time-series variation in promotion probability, wage progression, worker flow, and bonus ratio. Therefore, rather than constructing an explicit theoretical model, we empirically examine combinations of management policies based on establishment-level panel data.

2. What We Did and What We Did Not

The final goal of this study is to provide an empirical overview of the mix of incentives used by establishments, centered on promotion policy. In particular, we consider the roles of the selection scheme and the wage scheme. Selection schemes include **promotion opportunities** and **worker separations**, which reallocate workers between managerial and nonmanagerial positions¹ and between the firm and other firms. Incentive tools categorized as wage schemes include **progressive base wages** and **bonus payments**, which should maintain the motivation of workers who are not promoted. Based on the theoretical framework proposed by Frederiksen and Takáts (2009), Figure 1 provides an overview of the establishment-level incentive mix discussed in this study.²

Figure 1: Illustration of an Establishment's Incentive Mix



¹ We focus on promotions between middle managers (i.e. first tier of managerial positions) and nonmanagerial positions, although we supplementary discuss a three-tier model consisted of senior managers, middle managers, and nonmanagerial positions in the Appendix (see Figure 1).

² Because our data set is tabulated at the establishment level, we have assumed that the design of incentive mix is determined by each establishment.

2.1 Tournament size and prize

As shown by DeVaro (2006b), promotion opportunities are regarded as a particularly effective means of rewarding workers for performance in a highly visible manner.³ Therefore, we set the starting point of this study on classic tournament theory, and our first research question is whether this theory fits well across establishments in an economy. In order to answer this question, we use one of the typical empirical approaches for analyzing the relationship between a worker's promotion probability and the promotion prize, which was used by, for example, Bognanno (2001). Our first hypothesis is as follows:

Hypothesis 1: *The ratio of managers to nonmanagerial workers is negatively correlated with promotion prizes.*

A lower manager-to-worker ratio implies a lower probability of promotion for each worker, which requires larger amount of promotion prizes to motivate workers in the promotion competition. This negative relationship has been repeatedly confirmed in the literature, based on evidence mainly from the professional sport tournaments and promotions among executives. In contrast, this study examines such as statistical relationship in the average establishment in the Japanese economy, demonstrating to what extent tournament theory can explain the wage structure of an entire labor market.

2.2 The effect of worker separation on the prize amount

Next, we consider the role of the selection scheme through the effect of worker flows. Worker inflows and outflows both should affect the hierarchical structure and future promotion competition—quantitatively as well as qualitatively. For example, if worker outflow is always greater than worker inflow, the size of the contestant pool could shrink with tenure, which would result in a higher probability of promotion for workers who remain with the firm. In addition to affecting tournament size, however, worker flows may affect the extent of heterogeneity of the workers who stay and from which managers will be chosen; introducing such bias into the tournament would affect the prize amount (Meyer (1992)).

The previous literature, such as Bidwell (2011), has repeatedly reported that

³ In this study, promotion is defined as the transition from a nonmanagerial position to a managerial position or the transition from one managerial position to another.

dismissal is likely to separate inferior workers from the firm. We argue that separation of relatively inferior workers occurs not only through dismissals but also through voluntary separations. This argument is based on the idea that workers are likely to leave their current employers, because they can find relatively better opportunities from other employers if their expected probability of promotion is quite low or they expect limited wage increases unless they are promoted. If the worker flow results in such positive selection, the ability of the remaining workers in the contestant pool may be relatively high. In such a situation, to induce the appropriate effort, the firm must offer a prize that increases faster, in correspondence with the curvature of the convex cost function.⁴ This same logic explains why tournament prizes in professional sports are skewed (e.g., Bognanno (2001)).

On the contrary, in some previous studies, such as Gibbs (1995) and Lazear (1992), the authors have indicated negative selection. In that case, relatively superior workers may be more likely to quit if they can find better opportunities from other employers easily or if they feel underappreciated (see the optimal quit story in Chan (2006)). However, given the underdevelopment of external labor markets in Japan, our default argument is that positive selection plays a more dominant role than negative selection. Therefore, the second hypothesis that we will examine is the following:

Hypothesis 2: *Given the size of the contestant pool, the promotion prize is positively related to separation rate, which indicates a positive selection through worker separations.*

In order to focus on the influence of worker outflow on tournament structure, we make two relatively strong assumptions. The first is that worker inflow does not influence the existing tournament structure. For example, firms usually hire new workers at the same time as separation occurs, and we expect that these external hires are not included in the existing contestant pool. In other words, existing employees and external hires do not constitute the same contestant pool; thus, neither the quality nor the number of external hires relative to existing employees affects the existing hierarchical structure. Possible explanations for this assumption are firm-specific human capital, employers' imperfect information about the quality of external hires, and a handicapping mechanism that favors internal contestants (Chan (2006)).

The second assumption is that there are no external hires at the managerial level. In order to select workers, employers must rely on certain information, and DeVaro (2006a)

⁴ There is another assumption that workers effort in a promotion tournament is an increasing function of the average qualities of the contestants.

found that relative information about workers' performance matters in determining promotions, which is consistent with how internal promotion competitions work in many organizations. Chan (2006) also suggested that proven ability of internal candidates dominates qualifications of external contestants. Given that the majority of managerial vacancies at Japanese establishments are still filled by internal competition, we maintain this assumption.

2.3 The effect of worker separation on wage progression and bonus payments for those who stay

Although the positive relationship between promotion prize and worker separation indicates positive selection through worker separation, we confirm the mechanism through the role of worker separation on wage progression and bonus payments for those employees who remain at the firm (i.e., the losers of promotion tournaments who stay in nonmanagerial positions). If there is positive selection through separation, high-separation establishments keep more able workers in nonmanagerial positions than do low-separation establishments, which leads to greater average marginal productivity of the employees who remain with the firm. Therefore, the third hypothesis to be examined is as follows:

Hypothesis 3a: *The slopes of the wage-tenure profiles for survivors of high-separation establishments are steeper than those of low-separation establishments.*

Employers that have sufficiently high separation rates do not need to resort to positive bonus payments to provide incentives. The roles of the bonus as an incentive tool can be reduced in this case, because the marginal productivity of the employees who remain increases and they receive correspondingly steeper wage progression.

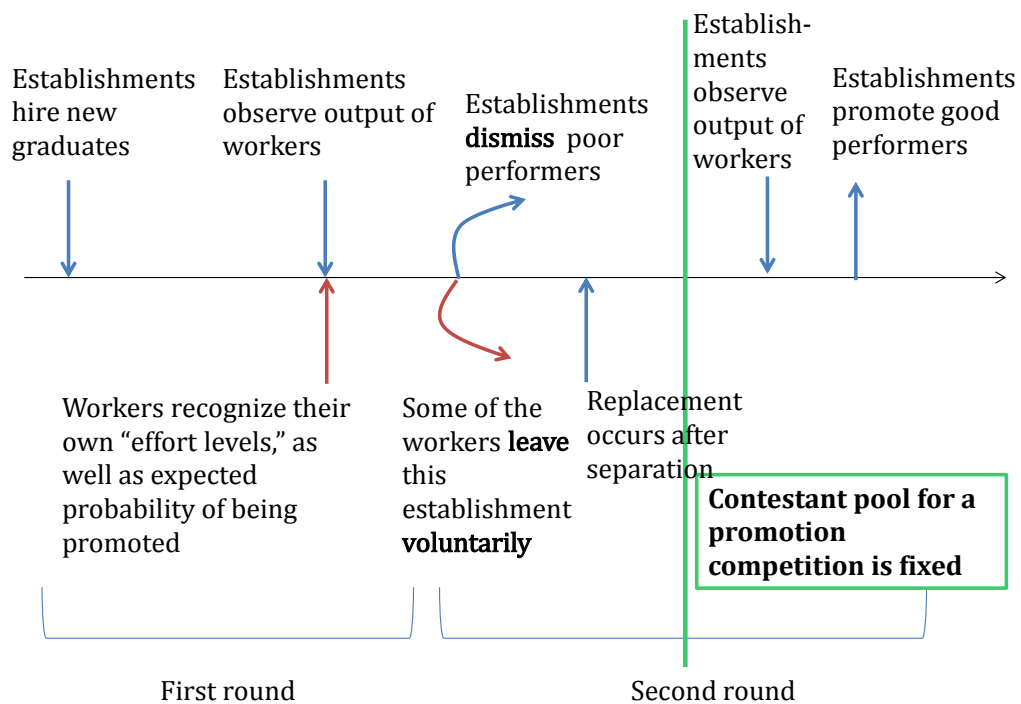
Hypothesis 3b: *The slopes of the bonus-tenure profiles for survivors of high-separation establishments are shallower than those of low-separation establishments.*

2.4 The timing of the theoretical framework

Although we do not formally present a theoretical model in this study, we assume a simple story of the decision-making processes of employers and employees to help readers to understand the mutual relationship among these three hypotheses. These hypotheses describe certain equilibrium, relying on the basic structure of a formal model including Frederiksen and Takáts (2009) that links promotion tournament and worker flows by deriving firms'

optimal incentive mix. Figure 2 shows the time frame of the hypotheses, which consists of two rounds. At the beginning of the first round, the establishment hires new, inexperienced workers, such as new graduates. Therefore, these workers do not know their own quality (e.g., they do not know how much they can accomplish when they make effort). We assume that the establishment offers to each of these workers an employment contract that includes fixed wages and potential bonuses and describes the opportunities for promotion, and the grounds for dismissal. In addition, we assume that workers are heterogeneous in terms of ability: some workers have high ability, while others have low ability. At the beginning of the first round, the workers' ability is observable neither by the employer nor the workers themselves. In this first round, the workers do not choose their effort level; instead, everyone makes the best effort they can. As a result, at the end of the first round, workers can observe their own ability relative to their peer workers. Therefore, at the end of the first round, workers can form clear expectations of their probabilities of promotion, because they recognize how good they are relative to their peers.

Figure 2: Tournament flow



At the beginning of the second round, employers dismiss some of the employees who performed poorly in the first round. Of the remaining workers, those who estimate a low probability of promotion leave the establishment voluntarily. Employers hire replacements for the separated workers, which fixes the contestant pool for the upcoming promotion

competition. Based on the information about the establishment's hierarchy structure and the fixed pool of contestants, workers choose their effort levels. At the end of the second round, good performers are promoted. This story is based on our key assumption of positive selection, which works through either dismissals or voluntary separations at the beginning of the second round of the tournament.

3. Data

In this study, we employ micro-level data from two establishment surveys conducted by the Japanese government. The first survey is the Wage Census of the Ministry of Health, Labour and Welfare (MHLW), a survey of establishments that is conducted annually as of each June. The survey draws samples from establishments in all industries except for agriculture. Based on payroll records, the surveyed establishments are requested to provide details of the earnings and work hours of each randomly selected employee.

Individual information about employment status, tenure, rank, and occupation is also available from the Wage Census. There are four supervisory ranks in the Wage Census; of them, we classify *Kacho* as a middle manager.⁵ According to the instructions provided by the MHLW, middle manager is defined as a position responsible for a function in an organization. For example, in an automobile manufacturing firm, the manager of the research department is classified as a middle manager, for the purpose of the survey. Here, the estimated results that we present in this study are for promotions for middle managers.

The Wage Census, on the other hand, classifies *Bucho* as a senior manager which is defined as positions that manage an entire unit or independent organization; some senior managers (e.g. CIO and CFO) may be included in the firm's board of directors. For example, the factory manager is classified as a senior manager. Because the senior manager is likely to be a member of the executive board, promotions to senior manager are less relevant to describing competition in the majority of labor markets. In the Appendix, we include supplementary discussion, taking account of future possibility of further promotion to senior managers.

The total pecuniary compensation of each worker in the Wage Census consists of a fixed component, overtime pay, and bonus payments. The promotion reward is expressed relative to the guaranteed portion of the employee's pay, which we calculate as the fixed component of monthly salary divided by the scheduled monthly work hours (i.e., hourly base

⁵ In addition, the survey includes the following supervisory ranks: *Kakaricho* (section leader), *Shokuchō* (production line leader), and *Bucho* (senior manager).

wage). Bonus payments are discussed later in this study as a separate incentive device.

Because we recognize promotion as one of the important incentive tools, we focus only on regular, full-time employees as major members of the contestant pool of promotion competitions.⁶ Finally, from the Wage Census, we use the ratio of aggregate overtime hours of all employees to the total hours worked by all employees at an establishment as a proxy for temporary demand shock at each establishment.

The second source of data is the MHLW's Employment Trend Survey (ETS), a biannual survey of establishments, which is conducted at the end of each June and December. The population of the ETS is Japanese establishments that employ at least 5 regular workers. Many of the sample establishments are replaced annually, but a sizable number of establishments are surveyed for longer than one year. This allows us to construct a short establishment-level panel data set for the years 2005-2011; the data set contains more than 10,000 observations, or approximately 2,000-2,500 observations per year. The ETS aims to collect aggregate information about the current status of employees at the two survey times during the year and about the employee inflows and outflows that occur during the intervening six-month periods (January-June and July-December), just as the biannual version of Job Openings and Labor Turnover Survey by the U.S. Bureau of Labor Statistics. In addition, the ETS provides detailed information about the composition of workers (full-time vs. part-time) and the composition of worker outflows by reason (e.g., dismissals, mandatory retirement, poor health, and other personal reasons). Because the Wage Census is conducted annually, we calculate annual dismissal rates and voluntary separation rates for each establishment. The ETS also provides information about the total employment of each establishment and its growth rate.

We combine the data from the Wage Census and the ETS, at an establishment level, by using the common establishment ID, which is derived from the establishment list in the Establishment and Enterprise Census. Through this process, we drop many observations, particularly those of small establishments, which are less likely than large establishments to be matchable between the two surveys' data sets. As a result, large establishments comprise a much greater share of our data set than of the original data sets, which may bias our findings. Still, merging the results of these two surveys into a panel data set is quite meaningful: We can use the combined data on wage structure and worker flows at the establishment level, and we can control for establishment fixed effects.

⁶ Given the duality in Japanese labor markets, nonstandard workers (as opposed to regular workers) are not included in promotion contests, even at the beginning of their careers. Ono (2010) provided a useful survey of the Japanese employment system.

Table 1-1: Summary statistics of major variables used in the estimation of equation (1)

		mean	sd	p25	p50	p75	N
Manager ratios	Ratio of middle managers to nonmanagerial workers	0.110	0.149	0.000	0.059	0.150	8,802
	Ratio of senior managers to nonmanagerial workers	0.057	0.136	0.000	0.000	0.063	8,806
	Ratio of senior managers to middle managers	0.462	0.676	0.000	0.250	0.667	6,327
Separation rates	Dismissal rate	0.040	0.093	0.000	0.006	0.042	9,359
	Voluntary separation rate	0.037	0.084	0.000	0.001	0.039	9,359
	Separation rate	0.077	0.172	0.000	0.011	0.081	9,359
	Separation rate (before crisis)	0.061	0.137	0.000	0.000	0.061	4,362
	Separation rate (after crisis)	0.091	0.197	0.000	0.020	0.099	4,997
Other control variables	Employment growth	-0.001	0.090	-0.019	0.000	0.018	9,359
	Overtime ratio	0.083	0.056	0.039	0.077	0.118	8,718

Table 1-1 provides partial summary statistics for the variables used in the following estimation. The average ratio of managers to nonmanagerial workers, which we regard as a proxy index of the ease with which a worker can be promoted to a managerial position,⁷ is approximately 0.110 for middle managers and 0.057 for senior managers. Due to the random sampling of individual records within establishments, more than 25% of establishments do not include any middle-manager observations.

The average dismissal rate is 4.0%, while of the average voluntary separation rate is 3.7%. The dismissal rate is comparatively high, relative to other periods, because the data set covers the years around the global financial crisis. An establishment's separation rate is defined as the sum of its dismissal rate and its voluntary separation rate. Because we assume that some structural changes in the trend of worker separation would have occurred after the global financial crisis, we provide separation rates before the crisis (2005-2007) and after the crisis (2008-2011). The results indicate that the distribution of separation rate shifted to the right, to some extent, after the crisis. In other words, the post-crisis distribution has a longer right tail than does the pre-crisis distribution, because several establishments had quite high separation rates after the crisis.

4. Estimation process

⁷ This proxy index is derived based on the ratio of stock variables at a point in time. As is discussed in section 1 of this paper, tournament theory focuses on the relationship between the probability of promotion and the associated prizes. Although the derived index does not provide information about the transition probability for workers moving into managerial positions, we consider it a good proxy for the shape of the hierarchy at each establishment.

4.1 Promotion premiums

As the first step, we estimate promotion prizes for each establishment and for every period. We assume that these prizes are set, at the establishment level, every year. We also assume that they are set as level shifts from one wage-tenure profiles to another. Thus, the prizes for promotions to middle manager are evaluated as a step from nonmanagerial worker to middle manager, after controlling for the human capital attributes of the individual being promoted⁸. We consider these promotion prizes to be establishment-specific, thus all newly promoted managers at the same establishment receive the same prizes as do their newly promoted colleague managers. Therefore, we estimate the following Mincer-type wage equation with dummy variables for middle managers by using observations of nonmanagerial workers as well as middle-class managers:

$$\begin{aligned} \ln(w)_{it}^j = & \alpha^{jt} + \beta_1^{jt} * tenure_{it}^j + \beta_2^{jt} * (tenure_{it}^j)^2 + \gamma_1^{jt} * age_{it}^j + \gamma_2^{jt} * (age_{it}^j)^2 \\ & + \Omega^{jt} * education_{it}^j + \delta^{jt} * gender_{it}^j + \rho_1^{jt} * Kacho_{it}^j + \varepsilon_{it}^j \quad (1) \end{aligned}$$

in which the observations are regular, full-time workers, who are regarded as candidates in the promotion competition, j is an establishment, t is a period, subscript i represents an employee, $tenure_{it}^j$ is the number of years of tenure for employee i working at j in period t , and $Kacho_{it}^j$ is equal to 1 if employee i working at j is a middle manager in period t . For the dependent variable, we use log-linearized hourly base wage. The coefficient ρ_1^{jt} is the premium offered to a middle manager at establishment j in period t .

One possible concern with regard to the premiums in equation (1) is their statistical significance. Even after limiting the observations to those establishments that employ more than 20 employees, some of the establishments employ only one or two middle managers; therefore, the standard errors of the estimated coefficients ρ_1^{jt} are unignorablely large. In order to test the robustness of the estimation parameters for equation (1), we estimate the same wage equation but by pooling all observations by establishment, regardless of time period, as indicated by equation (2) and compare the estimated coefficients of equations (1) and (2).

$$\begin{aligned} \ln(w)_i^j = & \alpha^j + \beta_1^j * tenure_i^j + \beta_2^j * (tenure_i^j)^2 + \gamma_1^j * age_i^j + \gamma_2^j * (age_i^j)^2 \\ & + \Omega^j * education_i^j + \delta^j * gender_i^j + \rho_1^j * Kacho_i^j + \varepsilon_i^j \quad (2) \end{aligned}$$

Figure A-1 in the Appendix shows the relationship between (ρ_1^{jt}, ρ_1^j) for those that are estimated with sufficient significance (i.e., t-statistics greater than 2). In this figure, many

⁸ We supplementary estimate middle-manager premiums under three-tier model (i.e. *Bucho*, *Kacho*, and non-management). Details are included in Appendix.

observations are distributed along the 45 degree line. The correlation between the two sets of results is high and significant: 0.612 (p-value: 0.000) for middle-manager premiums. The positive correlations between the two sets of estimated coefficients imply that manager premiums are rather stable at each establishment during the estimation period and that they are estimated with accuracy even in the year-by-year specification given by equation (1). Therefore, in the following analysis, we use the manager premiums estimated from equation (1).

The other concern regarding equation (1) relates to the assumption equal coefficients for human capital variables among managers and nonmanagerial workers. If the slope of the wage-tenure profile changes after promotion, the promotion prizes estimated from equation (1) should exhibit an omitted variable bias. Although directly measuring the sign or magnitude of these biases would be difficult, we provide a clear example that supports our assumption of equal coefficients before and after promotion. Figure A-2 in the Appendix shows three examples of wage-tenure profiles for government bureaucrats (note that the government is often referred as the benchmark for a large company in Japan). The figure shows the schedule of monthly base salary for a regular government bureaucrat for the combination of ranks and levels. Rank corresponds to the person’s position in the establishment’s hierarchical ladder; thus, the promotion is linked to the shift from a lower rank to a higher rank. If a worker stays at the same rank, he or she usually shifts to a greater level, with one additional year of tenure, as a result of having accumulated experience. The profiles in each rank—nonmanagerial worker and middle manager—are almost parallel with one another, implying that the omitted variable bias must not serious.

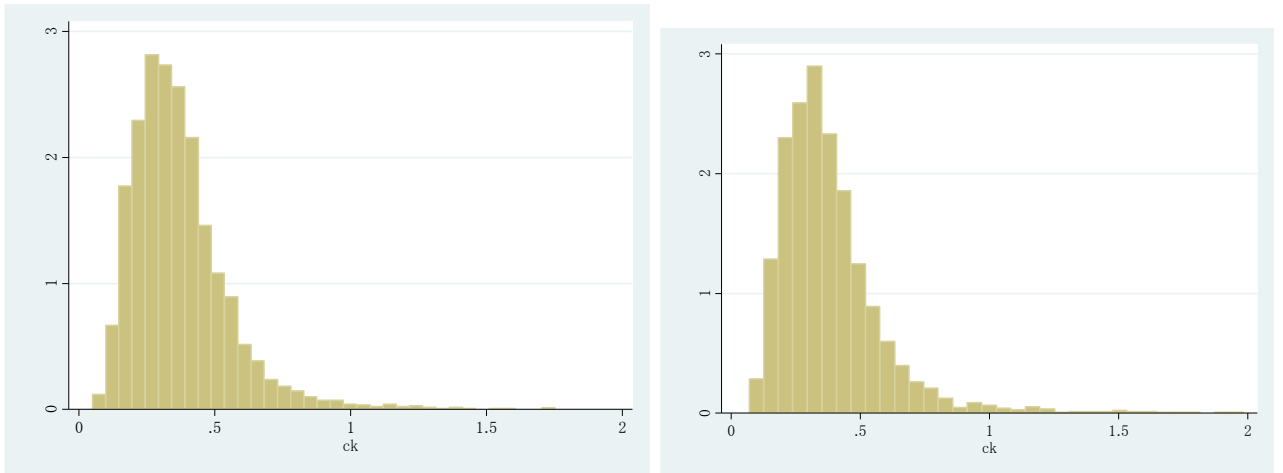
Given the caveats with regard to the estimated manager premiums, the next table, Table 1-2, reports summary statistics for the estimated promotion prizes for middle managers; the statistics labeled “annual” are estimated from equation (1), and the statistics labeled “all years” are estimated from equation (2).

Table 1-2: Summary statistics of major variables used in the estimation of equation (2)

	mean	sd	p25	p50	p75	N
Promotion premiums						
Premiums for middle managers, annual, hourly-based scheduled wage	0.392	0.335	0.253	0.341	0.455	3,000
Premiums for middle managers, all years, hourly-based scheduled wage	0.360	0.357	0.226	0.312	0.419	2,098
Premiums for middle managers, annual, scheduled wage	0.382	0.324	0.249	0.340	0.452	3,482
Premiums for middle managers, all years, scheduled wage	0.353	0.342	0.223	0.314	0.419	2,354

The mean middle-manager premium, as a percentage of base wage, estimated on an annual basis is 38.2% (with an interquartile range of 20.3 percentage points), and that estimated by pooling observations by establishment is 35.3% (with an interquartile range of 19.6 percentage points), quite consistent with the expectation based on Figure A-1. The mean middle-manager premiums, as a percentage of hourly base wage, estimated on an annual basis and by pooling observations are 39.2% and 36.0% (with an interquartile range of 20.2 and 19.3 percentage points), respectively. Figure 3 shows the histograms of the premiums for middle managers with regard to hourly base wage and monthly base wage (left panel and right panel of the figure, respectively) estimated based on equation (1) and (2). Middle-manager premiums have a distinct peak at approximately 35-40%, and beyond this level, they tend to have a long tail on the right-hand-side up to around 120%.

Figure 3: Histograms of middle-manager premiums (hourly scheduled wage (left) and monthly scheduled wage (right))



4.2 Hypothesis testing

Based on the estimated promotion prizes for each establishment, we then examine the relationships between these prizes and two key factors: the establishment's hierarchical structure and the establishment's worker outflow. To this end, we estimate the following equation without assuming any causal relationships between the prizes and the two factors:

$$\begin{aligned}
 Kacho_{premium,t}^j &= \omega^K * ratio\ of\ middle\ managers_t^j + \Phi^K * worker\ separation\ rates_t^j + \rho^K \\
 &* employment\ growth_t^j + \varphi^K * overtime\ ratio_t^j + \mu_j^K + \varepsilon_t^j \quad (3)
 \end{aligned}$$

in which $Kachopremium_t^j$ is the middle-manager premium⁹, $worker\ separation\ rates_t^j$ is either a vector of dismissal rates and voluntary separation rates or a vector of separation rates (i.e., the sum of the dismissal rate and the voluntary separation rate).

According to our hypothesis 1, we expect the coefficient ω^K to be negative, because a higher ratio of middle managers to nonmanagerial workers implies higher probability of promotion for each candidate engaged in the competition, which allows the employer to offer relatively smaller promotion prizes for the lower levels of effort required of workers. This coefficient will show whether promotion provides an effective economic incentive in the average Japanese organization. Our hypothesis 2 can be tested by the sign of coefficient Φ^K , which is expected to be positive, because a higher separation rate tends to intensify promotion competition among the remaining workers if the worker selection scheme is applied in a positive manner. These two coefficients will inform us of the statistical relationship between tournament structure and the selection mechanism inside typical Japanese firms.

In equation (3), we further incorporate two control variables. First, $employment\ growth_t^j$ controls for the effect of overall employment growth at the establishment, which can affect the promotion prizes independently from changes in the establishment's hierarchical structure. Second, $overtime\ ratio_t^j$, the ratio of overtime hours to total work hours at the establishment, is a proxy for an establishment-level demand shock.

To exploit our source of identification from the within-variation in the firm, we basically control establishment fixed effects, taking advantage of establishment-level panel dataset. This means that the estimated ω^K and Φ^K provide statistical inference regarding the change in promotion premium when the firm changes its tournament size or separation rates. Management practices are expected to vary to a great extent depending on business conditions or corporate identities. Therefore, the pressure for the employers to motivate their workers should vary. Controlling fixed-effects in equation (3) would be thus important. However, one may wonder whether the data provides sufficient variation within a firm. To confirm the robustness of the estimation results, we also analyze the data's cross-sectional variation and estimate the coefficients by use of a random-effects model as well as ordinary least squares (OLS). The estimation results of these baseline specifications for middle managers are shown in Table 2-1.

⁹ We limit the observations of estimated premiums to those estimated with t-value equal to or greater than 2 in the first-stage estimation.

Table 2-1: Baseline estimation results (middle manager, fixed hourly salary) of equation (3)

	Fixed-effects model		Random-effects model		Cross-sectional model	
Ratio of middle managers to nonmanagerial workers	-0.672** (0.323)	-0.683** (0.325)	-0.889*** (0.140)	-0.892*** (0.139)	-0.779*** (0.0873)	-0.783*** (0.0876)
Dismissal rate	0.144* (0.0819)		0.147 (0.0913)		0.171 (0.129)	
Voluntary separation rate	0.0279 (0.0760)		0.0658 (0.112)		-0.0247 (0.110)	
Separation rate		0.0579 (0.0645)		0.109 (0.0744)		0.0879 (0.0933)
Employment growth	0.0557 (0.0645)	0.0463 (0.104)	-0.0174 (0.101)	-0.0126 (0.0995)	-0.0896 (0.120)	-0.167 (0.164)
Overtime ratio	0.0253 (0.105)	0.0869 (0.0589)	0.256 (0.183)	0.263 (0.178)	0.291 (0.203)	0.361 (0.233)
Constant	0.357*** (0.0211)	0.358*** (0.0210)	0.386*** (0.0266)	0.387*** (0.0274)	0.362*** (0.0307)	0.367*** (0.0317)
Number of Observations	2,599	2,599	2,609	2,609	2,609	2,609
R-squared	0.008	0.007			0.012	0.012
Number of establishments	1,840	1,840	1,850	1,850		

Robust standard errors are shown in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the fixed-effects model, weights = 1 / Standard error of middle-manager premiums

We obtain statistically significantly negative signs for ω^K in all models, which implies that a greater probability of promotion is linked to a reduced promotion premium. These results are robust and the estimates of ω^K are almost the same level notwithstanding the estimation model. Thus they can be interpreted as consistent with tournament theory even in an average firm among various industries.

By comparing the estimation results of the three model types, we see that although the derived implications are all consistent, the fixed-effects models produce smaller coefficients in absolute terms. Therefore, we consider that unobservable technological factors may influence the base wage level of managers at the same time as does the establishment's hierarchical structure. For example, in the assembly industry, the hierarchy is likely to be skewed but the promotion premium relatively low due to the business's lower profitability. In contrast, an IT company, despite its rectangular organization, may offer larger promotion premiums for managers. Therefore, we consider that such unobserved heterogeneity among establishments needs to be controlled for in our estimation. Indeed, Rajan and Wulf (2006) pointed out recent changes in senior-management hierarchy (e.g., an increase in the number of CEOs) and their correlation with changes in wages. In addition, the distribution of firms may have changed due to the global financial crisis. These considerations show that the cross-sectional variation may include a potential bias in the statistical relationships that we are analyzing. Therefore, we will underline the results of the fixed-effects models in the following

discussion.

In contrast to ω^K , the coefficients of separation rates (Φ^K s) are estimated as positive but generally not significantly different from zero. However, this statistical non-significance changes under an alternative specification. Table 2-2 reports the estimation results when interaction terms between separation rate and dummy variables for the years after the global financial crisis are included.

Because the whole distribution of separation rates shifted to the right after the crisis, we expect that there may have been an establishment-level change in the effect of selection scheme and the average increase in separation rates.

Table 2-2: Application estimation results (Middle manager, fixed hourly salary, all models)

	Fixed effects model		Random effects model		Cross-section	
Ratio of middle managers	-0.722**	-0.741**	-0.858***	-0.865***	-0.742***	-0.746***
	(0.325)	(0.327)	(0.132)	(0.132)	(0.0847)	(0.0870)
Dismissal rate	0.0861		0.0154		0.0146	
	(0.0824)		(0.117)		(0.184)	
Voluntary separation rate	-0.191**		-0.133		-0.116	
	(0.0889)		(0.0901)		(0.120)	
Separation rate		-0.00747		-0.0438		-0.0427
		(0.0661)		(0.0810)		(0.122)
Dismissal rate*(after crisis)	0.106		0.292*		0.337*	
	(0.0840)		(0.151)		(0.198)	
Voluntary separation rate*(after crisis)	0.259***		0.239*		0.111	
	(0.0921)		(0.138)		(0.139)	
Separation rate*(after crisis)		0.131**		0.247*		0.225*
		(0.0625)		(0.127)		(0.122)
Employment growth	0.0648	0.0637	-0.0110	-0.00120	-0.159	-0.133
	(0.0659)	(0.0659)	(0.101)	(0.100)	(0.164)	(0.164)
Overtime ratio	0.113	0.129	0.360*	0.364*	0.422*	0.402*
	(0.122)	(0.120)	(0.210)	(0.209)	(0.241)	(0.244)
Constant	0.353***	0.356***	0.375***	0.380***	0.354***	0.361***
	(0.0212)	(0.0209)	(0.0284)	(0.0291)	(0.0313)	(0.0324)
Observations	2,599	2,599	2,609	2,609	2,609	2,609
R-squared	0.016	0.012			0.015	0.014
Number of establishments	1,840	1,840	1,850	1,850		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In fixed effects model, Weights=1/(Standard errors of Middle manager premiums)

The results in Table 2-2 vividly show that the relationships between voluntary separation rates and promotion prizes were negative before the crisis but turned positive after the crisis. Furthermore, the relationships between dismissal rates as well as separation rates and promotion prizes became positive and statistically significant after the crisis, in the fixed-effects and random-effects model. These positive signs can be interpreted as consistent

with the story of positive selection. Under a positive selection scheme, higher separation rates are associated with the elimination of inferior workers to a greater extent than are lower separation rates, leaving behind a candidate pool of employees with higher ability. As a result, the promotion competition becomes more intense. Therefore, employers must reward the winners with larger promotion prizes to provide sufficient motivation for the candidates, given the convexity of the cost function associated with worker effort (Rosen (1986)).

The interpretation of the negative coefficient of fixed-effects model before the crisis is less straightforward. At least it does not indicate any clear direction regarding how the selection mechanism would work. If separation happens randomly among employees notwithstanding their quality, higher separation leads to a smaller number of candidates and therefore is associated with smaller promotion prizes. Before the global financial crisis, the Japanese economy was in a long boom with tight labor markets. We consider that, in that situation, workers were voluntarily leaving establishments for various reasons, including Chan's (2006) optimal quit story; thus, voluntary separation occurred not only among inferior workers but also among superior workers. This story is not inconsistent with the empirical results of negative coefficients.

Tables A-3 reports the estimation results for slightly different specifications from equation (3). Assuming that promotion options are offered to workers differently by small firms and large firms,¹⁰ we replace manager ratios with interaction terms between manager ratios and firm-size dummy variables for the firm with which the establishment is affiliated. The estimation results imply that the relationships between middle-manager ratios and middle-manager premiums are greater in magnitude at large firms (firms with more than 500 employees) than at small firms and that the coefficients are quite negative for both large firms and small firms. The results with regard to the relationship between voluntary separation rates and middle-manager premiums are positive but not significant at 10% level.

4.3 Evidence of positive selection

The estimation results already reported are, at least in part, consistent with our hypothesis of positive selection, hypothesis 2. In this subsection, we proceed to find additional supportive evidence for this hypothesis.

Our positive selection story implies that the longer a worker remains in a nonmanagerial position at the same establishment, the more often he or she has gone through

¹⁰ In this specification, we assume that the incentive mechanism is determined at the firm level rather than the establishment level.

the selection process as a survivor but not a winner of promotion. Therefore, the distribution of worker quality continues to shift to the right as the tenure as nonmanagerial workers increases. Although we do not have data on worker performance, we can use wage data to proxy for worker quality. Therefore, we expect relative steepness of wage-tenure profiles for lifetime¹¹ nonmanagerial workers, as the trajectories of selection process, compared with the slopes of the wage-tenure profiles for mid-career nonmanagerial workers. Similarly, the estimated wage slopes of candidates can be compared with those of non-candidates (e.g., mid-career workers hired as replacements) to estimate the average drift of candidates' quality. Because the effect of the selection of contestants should be greater at high-separation establishments, we expect steeper relative gradients at high-separation establishments than at low-separation establishments, as predicted by hypothesis 3a.

To capture how the relative gaps in gradients between “survivors of contestants” and “substitutes as non-contestants” evolve with tenure, we estimate the following wage equation:

$$\ln(w)_{it}^j = \alpha^S + B_1^S * tenure_{cat_{it}}^j + B_2^S * (tenure_{cat_{it}}^j * lifetime_{it}^j) + \gamma_1^S * age_{it}^j + \gamma_2^S * (age_{it}^j)^2 + \Omega^S * education_{it}^j + \delta^S * gender_{it}^j + \varepsilon_{it}^j \quad (4)$$

in which $tenure_{cat_{it}}^j$ represents a vector of dummy variables of categories of tenure (0-2 years, 2-5 years, 5-10 years, 10-15 years, 15-25 years, and 25 or more years) for worker i at establishment j at time t .¹² Given that $lifetime_{it}^j$ is a dummy variable that equals 1 for a lifetime worker, who has been employed by the same firm since he or she graduated from school, the column vector B_2^S shows the relative steepness of wage profiles of lifetime workers compared to wage profiles of mid-career workers, for each tenure category. The column vector is given as follows:

$$B_2^S = [\beta_{21}^S \quad \beta_{22}^S \quad \beta_{23}^S \quad \beta_{24}^S \quad \beta_{25}^S \quad \beta_{26}^S]^t$$

¹¹ We estimate, for each worker, the potential tenure, which is defined as the difference between the worker's current age and his or her age upon graduation from school, in order to distinguish lifetime workers from mid-career workers. We allow for 1-2 years discrepancy as an acceptable error in identifying lifetime workers.

¹² The implication derived from the estimation results based on dummy variables for years of tenure is generally consistent with the implication derived from the estimation results based on categories of tenure.

We then divide all of the observations of nonmanagerial workers into two groups¹³ ($s=H, L$) and estimate equation (4) separately for each of the groups; the first group consists of workers at high-separation-rate establishments ($s=H$), and the second group consists of workers at low-separation-rate establishments ($s=L$). Finally, in Figure 4, we show that the normalized estimated coefficient of the shortest tenure category ($\widehat{\beta}_{21}^S$) is zero for both high-separation-rate establishments and low-separation-rate establishments.

Figure 4: The relative steepness of wage-tenure profiles for high-separation-rate establishments and low-separation-rate establishments

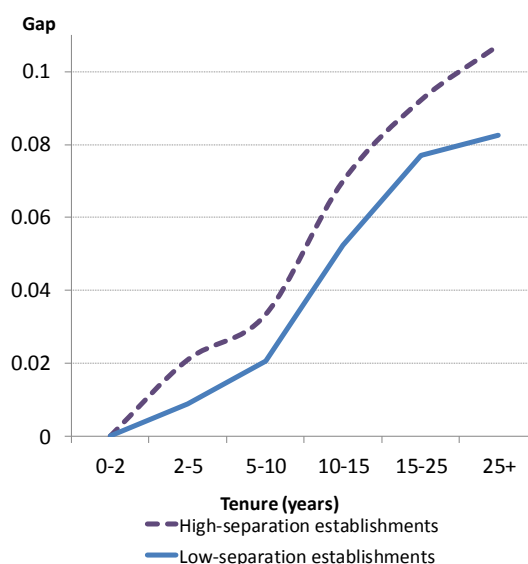


Figure 4 illustrates the evolution of the relative gap in the steepness of wage-tenure profiles of lifetime nonmanagerial workers and the steepness of wage-tenure profiles of mid-career nonmanagerial workers, by tenure category, at both high-separation and low-separation establishments. First, note that wage gaps continue to expand with tenure, for both high-separation and low-separation establishments. This phenomenon indicates that the productivity gap between survivors among lifetime workers and newly hired non-contestants” continuously expands as selection occurs. Second, by comparing the two lines in the figure, we can see that wage gap expands at a faster pace at high-separation establishments than at low-separation establishments. In a high-separation establishment, in which the candidate

¹³ We rely on the median separation rate to create these groups. The high-separation group contains relatively many small establishments in service industries, including medical services and restaurants, while the low-separation group contains relatively many large establishments in the manufacturing industry.

pool shrinks faster, the average ability of survivors increases more rapidly than does the average ability of new external hires. Both findings are perfectly consistent with our hypothesis of positive selection.

Of course, wage gaps that expand with tenure may be consistent with an alternative explanation (e.g., firm-specific human capital or employer learning), while the difference in wage gaps, for all tenure categories, based on establishments' separation rates (the difference between the two lines in Figure 4) does not fit well with the existing alternative explanations.

4.4 The role of bonus payments

Finally, we would like to briefly discuss the role of bonus payments as incentive tools. Bonuses are often regarded as incentive for nonmanagerial workers who have already missed the chances of promotion, as discussed by Frederiksen and Takáts (2009). In order to examine the role of bonuses in our positive selection framework, we use the same framework as in section 4.3 of this paper to examine how bonuses evolve with tenure among nonmanagerial workers.

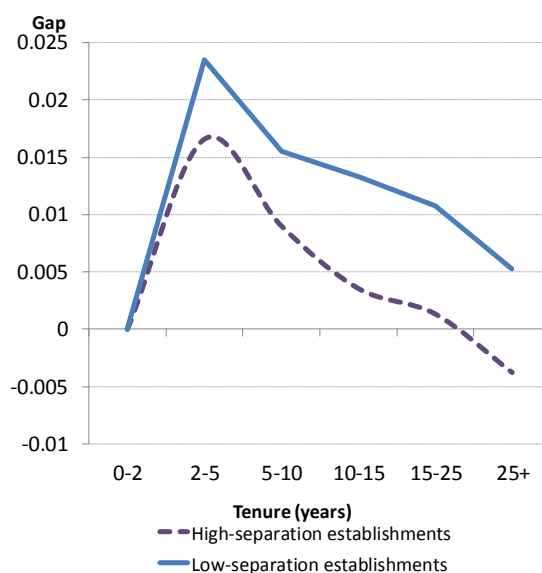
Therefore, we estimate the gap in the steepness of the bonus-tenure slopes of nonmanagerial workers—both lifetime and non-lifetime.

$$\frac{bonus_{it}^j}{fixed\ salary_{it}^j} = \alpha^S + B_1^S * tenure_{cat\ it}^j + B_2^S * (tenure_{cat\ it}^j * lifetime_{it}^j) + \gamma_1^S * age_{it}^j + \gamma_2^S * (age_{it}^j)^2 + \Omega^S * education_{it}^j + \delta^S * gender_{it}^j + \varepsilon_{it}^j \quad (5)$$

in which the dependent variable, *bonus*, is normalized by the fixed salary received by the same employee, *i*, in the same period, *t*, and all explanatory variables are the same as in equation (4).

Figure 5 shows how the bonus-ratio gaps evolve with tenure at both high-separation establishments and low-separation establishments. Although the bonus-ratio gap expands in the beginning of a worker's tenure (2-5 years vs. 0-2 years), it then declines when the worker's tenure exceeds 5 years. This results is the opposite of the result for the fixed wage. In addition, for the same tenure category, the steepness is always larger at low-separation establishments than at high-separation establishments.

Figure 5: the relative steepness of bonus-ratio profiles for high-separation-rate establishments and low-separation-rate establishments, by tenure category



Given Figure 5, establishments seem to employ bonuses as complements to other incentive tools (e.g., increases in fixed wages and a positive selection scheme). In other words, when these other incentive tools work in a sufficient manner, establishments do not need to resort to bonuses to motivate their employees, whereas when other tools fail to work sufficiently, establishments indeed need to employ bonuses as one of the incentive tools.

4.5 The role of worker inflows in the selection scheme

As discussed in section 2.2, so far we have assumed that worker inflows do not affect the candidate pool that already exists at an establishment. Therefore, we assume that all new hires—not only new graduates but also mid-career workers—are put in a separate candidate pool from the one that consists of their colleagues who are lifetime workers for the establishment, so that worker inflows do not influence the existing tournament structure among those lifetime workers. In reality, however, the size of the contestant pool may be affected not only by worker separations but also by worker inflows. Although we cannot identify the magnitude of the effect on the contestant pool, from the available data set, we can examine if there is a relationship between worker inflow rate and promotion prize.

Equation (6) is based on those equations that were used in examining the relationship between separation rate and promotion prize in section 4.2 (i.e., equation (3)).

$$\begin{aligned}
 Kacho_{premium,t}^j &= \omega^K * \text{ratio of middle managers to nonmanagerial workers}_t^j + \delta^K \\
 &* \text{worker inflow rates}_t^j + \tau^K * \text{Expected value of Bucho premium}_t^j + \rho^K \\
 &* \text{employment growth}_t^j + \varphi^K * \text{overtime ratio}_t^j + \mu_j^K + \varepsilon_t^j \quad (6)
 \end{aligned}$$

We employ two measures of worker inflow rate: one is the ratio of all new hires to all existing workers at an establishment, and the other is the ratio of only mid-career hires to all existing workers at an establishment.

Table 2-3 summarizes the estimation results for equation (6). Similar to the relationship between separation rate and prize, the relationship between worker inflow rate and prize is positive throughout the estimation period, but the relationship is not statistically significant, particularly in the years after the global financial crisis. Such positive relationships are intuitively plausible, because establishments that have higher separation rates tend to have higher worker inflow rates in order to replace those workers who leave. This leaves the possibility that (mid-career) worker inflow indeed does influence the tournament structure directly, either by changing the number of contestants or by influencing the average quality of candidates. Further investigation regarding how to interpret the results shown in Table 2-3 is left for future studies.

Table 2-3: Estimation results (Inflow, middle manager, fixed salary, fixed-effects model) of (6)

	Middle-manager premium	
Ratio of middle managers to nonmanagerial workers	-1.130** (0.511)	-1.193** (0.498)
Ratio of senior managers to middle managers		
Mid-career worker inflow rate	0.0927* (0.0542)	-0.0128 (0.0851)
Mid-career worker inflow rate *		0.131 (0.0800)
Post-crisis dummy variable		
Expected value of senior-manager premium	-0.350*** (0.113)	-0.347*** (0.115)
Employment growth	-0.0615 (0.0931)	-0.0425 (0.0971)
Overtime ratio	0.0219 (0.172)	0.108 (0.181)
Constant	0.379*** (0.0308)	0.377*** (0.0305)
Number of Observations	1,447	1,447
R-squared	0.103	0.109
Number of establishments	1,080	1,080

Robust standard errors are shown in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Weights = 1 / Standard error of middle-manager or senior-manager premiums

5. Conclusions

In this study, we have empirically examined Japanese establishments' incentive mix. By using an establishment-level panel data set that contains information on both selection schemes and wage schemes, we find supportive evidence of tournament structure, the correspondence between selection scheme and wage setting, and positive selection. To the best of our knowledge, there have been few studies of positive selection and the correspondence between selection scheme and wage setting at the establishment level.

In addition, we have found evidence that implies there may have been a change in establishments' selection policy after the global financial crisis. The results of our establishment-level analysis indicate that a positive selection mechanism became apparent just after the crisis. We consider that consistent with the fact that, before the crisis, the Japanese economy had been in a long boom and the labor market had been tight. In such a boom economy, workers may have been quitting voluntarily for reasons other than those in

our story, which means that not only inferior workers but also superior workers were leaving their establishments. In this regard, our story may better explain the incentive mix offered by establishments during recessions or when corporate profits are squeezed so that employers must be rather conscious about their profitability and strictly eliminate relatively inferior employees.

We leave several issues for future study. First, our findings are not contradictory of the market-based mechanism proposed by Waldman (1984), because when positive selection causes the variation in contestants' ability to shrink, the informational value of promotion increases for other employers in the market. This is related to the second caveat in this study, in which we assumed that worker inflows do not affect either the tournament structure or the selection scheme. Recently, however, quite a large amount of literature has been published on the issue of internal promotion vs. external recruitment. In addition, we have found that the relationship between worker inflow rate and promotion prize may be positive. There are obviously cases in which workers hired via external recruitment become contestants for promotion, along with the lifetime nonmanagerial workers. Extending our analysis to examine the influence of external hires on the incentive mix is important to use. Third, we do not explicitly discuss the relevance of the derived implications of this study to the recent major trends in the Japanese labor market, including the flattening wage-tenure profiles. Further extension of this study could be provide an interpretation of its results in light of recent developments in the Japanese labor market.

References

- Bidwell, M. (2011). Paying more to get less: Specific skills, matching, and the effects of external hiring versus internal promotion, *Administrative Science Quarterly*, 56(3), 369-407.
- Bognanno, M. L. (2001). Corporate tournaments. *Journal of Labor Economics*, 19(2), 290-315.
- Chan, W. (2006). External recruitment and intrafirm mobility. *Economic Inquiry*, 44(1), 169-184.
- DeVaro, J. (2006a). Internal promotion competitions in firms [electronic version]. *RAND Journal of Economics*, 37, 521-542.
- DeVaro, J. (2006b). *Strategic promotion tournaments and worker performance*. Retrieved [on December 21, 2015], from Cornell University's School of Industrial and Labor Relations at <http://digitalcommons.ilr.cornell.edu/articles/108/>.
- DeVaro, J., & Morita, H. (2013). Internal promotion and external recruitment: A theoretical and empirical analysis. *Journal of Labor Economics*, 31(2), 227-269.
- Frederiksen, A., & Takáts, E. (2009). Promotions, dismissals, and employee selection: Theory and evidence. *Journal of Law, Economics, and Organization*, 27(1), 159-179.
- Gibbs, M. (1995). Incentive compensation in a corporate hierarchy. *Journal of Accounting and Economics*, 19(2), 247-277.
- Lazear, E. P. (1992). The job as a concept. In William J. Bruns, Jr., ed., *Performance Measurement, Evaluation, and Incentives*. Boston, Harvard Business School Press, 183-215.
- Lazear, E. P., & Rosen, S. (1981). Rank-order tournaments as optimum labor contracts, *Journal of Political Economy*, 89, 841-864.
- Meyer, M. A. (1992). Biased contests and moral hazard: Implications for career profiles. *Annales d'Economie et de Statistique*, 25/26, 165-187.
- Ono, H. (2010). Lifetime employment in Japan: Concepts and measurements. *Journal of the Japanese and International Economies*, 24, 1-27.
- Rajan, R., & Wulf, J. (2006). The flattening firm: Evidence from panel data on the changing nature of corporate hierarchies. *Review of Economics and Statistics*, 88(4), 759-773.
- Rosen, S. (1986). Prizes and incentives in elimination tournaments. *American Economic Review*, 76(4), 701-715.
- Topel, R. (1991). Specific capital, mobility, and wages: Wages rise with job seniority. *Journal of Political Economy*, 99(1), 145-176.
- Waldman, M. (1984). Job assignments, signalling, and efficiency. *RAND Journal of Economics*, 15, 255-267.

Appendix

Tables A-2 and A-3 show the test results of Hypotheses 1 and 2 based on three-tier hierarchical model (i.e. non-management, *Kacho*, and *Bucho*). In this model, *Kacho* premium of establishment j in period t (ρ_1^{jt}) is estimated by the wage equation below (1A).

$$\begin{aligned} \ln(w)_{it}^j = & \alpha^{jt} + \beta_1^{jt} * tenure_{it}^j + \beta_2^{jt} * (tenure_{it}^j)^2 + \gamma_1^{jt} * age_{it}^j + \gamma_2^{jt} * (age_{it}^j)^2 \\ & + \Omega^{jt} * education_{it}^j + \delta^{jt} * gender_{it}^j + \rho_1^{jt} * Kacho_{it}^j + \rho_2^{jt} * Bucho_{it}^j + \varepsilon_{it}^j \quad (1A) \end{aligned}$$

where ρ_2^{jt} can be interpreted as an additional premium for senior managers.

The estimated *Kacho* premiums tend to be smaller than those in the main text (Table A-1).

Table A-1: Summary statistics of premiums for middle managers (Three-tier model)

	mean	sd	p25	p50	p75	N
Promotion premiums	0.237	0.296	0.098	0.210	0.351	3,375
Premiums for middle managers, annual, scheduled wage	0.239	0.469	0.108	0.210	0.338	3,249
Premiums for middle managers, all years, scheduled wage						

For hypothesis testing, we add a control variable of *Expected value of Bucho premium* $_t^j$ (the senior-manager premium multiplied by the ratio of senior managers to middle managers) to (3), as a proxy for the expected option values of future promotion premiums. Because some of the newly promoted managers will be promoted to senior managers in future and the option value of promotion can reduce the current premium without eliminating the incentive to work, we expect its coefficient τ^K to be negative.

$$\begin{aligned} Kacho_{premium,t}^j = & \omega^K * ratio\ of\ middle\ managers_t^j + \Phi^K * worker\ separation\ rates_t^j \\ & + \tau^K * Expected\ value\ of\ Bucho\ premium_t^j + \rho^K * employment\ growth_t^j + \varphi^K \\ & * overtime\ ratio_t^j + \mu_j^K + \varepsilon_t^j \quad (3A) \end{aligned}$$

The estimation results of 3A are shown in Table A-2. Table A-3 shows the results with interaction terms between separation rates and post-crisis dummy variables. Table A-4 contains the results when we take into account of the variation in firms' promotion policies depending on firm sizes.

Table A-2: Estimation results of three-tier hierarchical model
(middle managers, fixed hourly salary, all models)¹⁴.

	Fixed-effects model		Random-effects model		Cross-sectional model	
Ratio of middle managers to nonmanagerial workers	-1.894** (0.765)	-1.894** (0.764)	-0.773*** (0.138)	-0.773*** (0.138)	-0.639*** (0.0881)	-0.639*** (0.0878)
Dismissal rate	0.0703 (0.0863)		0.0451 (0.0718)		0.111 (0.0708)	
Voluntary separation rate	0.0653 (0.114)		0.0797 (0.122)		0.0509 (0.130)	
Separation rate		0.0683 (0.0785)		0.0578 (0.0713)		0.0930 (0.0717)
Expected value of senior-manager premium	-0.711** (0.343)	-0.710** (0.343)	-0.494** (0.196)	-0.494** (0.195)	-0.373*** (0.118)	-0.373*** (0.117)
Employment growth	0.140 (0.127)	0.140 (0.123)	0.000800 (0.157)	-0.00164 (0.154)	-0.126 (0.217)	-0.117 (0.211)
Overtime ratio	0.170 (0.165)	0.171 (0.161)	0.398** (0.194)	0.394** (0.188)	0.682*** (0.253)	0.682*** (0.253)
Constant	0.415*** (0.0353)	0.415*** (0.0354)	0.367*** (0.0284)	0.367*** (0.0285)	0.319*** (0.0323)	0.319*** (0.0323)
Number of Observations	1,845	1,845	1,852	1,852	1,852	1,852
R-squared	0.249	0.249			0.047	0.047
Number of establishments	1,260	1,260	1,267	1,267		

Robust standard errors are shown in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the fixed-effects model, weights = 1 / Standard error of middle-manager premiums

¹⁴ The number of observations used in the estimation of equation (A1) is quite limited compared to that used in the estimation of equation (3).

Table A-3: Application estimation results of three-tier hierarchical model
(middle managers, fixed hourly salary, all models)

	Fixed effects model		Random effects model		Cross-sectional model	
Ratio of middle managers to nonmanagerial workers	-2.001** (0.791)	-1.985** (0.795)	-0.751*** (0.135)	-0.765*** (0.136)	-0.605*** (0.0851)	-0.611*** (0.0845)
Dismissal rate	0.0788 (0.0852)		0.0222 (0.0693)		0.0300 (0.0983)	
Voluntary separation rate	-0.289*** (0.0735)		-0.198** (0.0844)		-0.132 (0.127)	
Separation rate		0.0305 (0.0704)		-0.0123 (0.0611)		-0.00448 (0.0758)
Dismissal rate*Post-crisis dummy variable	0.0637 (0.0718)		0.0833 (0.0886)		0.172 (0.149)	
Voluntary separation rate*Post-crisis dummy variable	0.472*** (0.135)		0.371*** (0.133)		0.252* (0.142)	
Separation rate*Post-crisis dummy variable		0.123* (0.0712)		0.146 (0.0889)		0.178 (0.112)
Expected value of senior-manager premium	-0.704** (0.336)	-0.704** (0.337)	-0.491** (0.193)	-0.490** (0.192)	-0.371*** (0.117)	-0.372*** (0.117)
Employment growth	0.205 (0.142)	0.182 (0.139)	0.0240 (0.162)	0.0178 (0.160)	-0.118 (0.219)	-0.104 (0.215)
Overtime ratio	0.303 (0.198)	0.264 (0.194)	0.471** (0.213)	0.463** (0.213)	0.728*** (0.271)	0.724*** (0.273)
Constant	0.405*** (0.0331)	0.406*** (0.0332)	0.360*** (0.0304)	0.359*** (0.0307)	0.314*** (0.0345)	0.314*** (0.0346)
Observations	1,845	1,845	1,852	1,852	1,852	1,852
R-squared	0.261	0.254			0.049	0.049
Number of establishments	1,260	1,260	1,267	1,267		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In fixed effects model, Weights=1/(Standard errors of Middle manager premiums)

Table A-4: Application estimation results (middle managers, fixed hourly salary, fixed-effects model)

	Middle-manager premium			
Ratio of middle managers to nonmanagerial workers* Large-firm dummy variable	-2.144*	-2.144*	-2.207**	-2.195*
	(1.094)	(1.095)	(1.124)	(1.126)
Ratio of middle managers to nonmanagerial workers* Small-firm dummy variable	-1.477**	-1.487**	-1.664**	-1.670**
	(0.640)	(0.625)	(0.735)	(0.736)
Dismissal rate	0.172*			
	(0.0966)			
Voluntary separation rate	0.127			
	(0.152)			
Separation rate		0.149		
		(0.0943)		
Dismissal rate*(after crisis)			0.278	
			(0.169)	
Voluntary separation rate*(after crisis)			0.191	
			(0.174)	
Separation rate*(after crisis)				0.237
				(0.155)
Employment growth	0.127	0.128	0.139	0.144
	(0.0859)	(0.0847)	(0.0984)	(0.0981)
Overtime ratio	0.128	0.136	0.271	0.275
	(0.208)	(0.196)	(0.267)	(0.267)
Constant	0.428***	0.429***	0.423***	0.424***
	(0.0321)	(0.0312)	(0.0305)	(0.0305)
Observations	2,609	2,609	2,609	2,609
R-squared	0.019	0.019	0.028	0.028
Number of N2	1,850	1,850	1,850	1,850

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Weights=1/(Standard errors of Middle manager premiums)

Figure A-1: Comparison of middle-manager premium

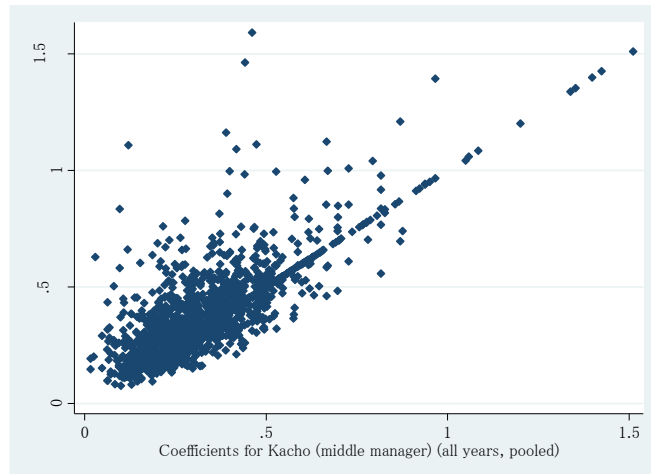


Figure A-2 Wage progression
Yen (monthly scheduled wage, government bureaucrat)

