RIETI Discussion Paper Series 13-E-038

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http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 13-E-038
First draft: May 2013
Revised: December 2013

Dynamics of the Gender Gap in the Workplace: An econometric case study of a large Japanese firm

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Abstract

This paper provides new evidence on the nature and causes of the gender pay gap using confidential personnel records from a large Japanese manufacturing firm. Controlling only for the human capital variables that are typically included in the standard wage function results in a substantial gender pay gap—16% for unmarried workers and 31% for married ones. However, additionally controlling for job level, skill grade, hours worked, and number of dependents almost eliminates the "unexplained" gender pay gap. We estimate various models of promotion rates and additionally find that (i) there is a statistically and economically significant correlation between the hours worked and the odds of promotion for women but not for men; (ii) maternity carries a substantial career penalty (up to a 20-30 percentage-point fall in future earnings), especially for college graduate women; and (iii) the maternity penalty can be avoided by promptly returning from parental leave and not reducing work hours after returning. As such, our evidence points to the importance of women's ability to signal their commitment to work (or the level of family support they receive)—through working long hours and taking shorter parental leave—for their career advancement.

Keywords: Gender pay gap, Statistical discrimination, Signaling, Career interruption, Promotion.
JEL classification: J16, J31, M51

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This study is conducted as a part of the Project "Economic Analysis of Human Resource Allocation Mechanisms Within the Firm: Insider econometrics using HR data" undertaken at Research Institute of Economy, Trade and Industry (RIETI).

1. Introduction

The gender pay gap is a persistent aspect of every country's labor market (Blau 2003), and it is especially large and tenacious in the Japanese labor market. Although the gap narrowed significantly over the past few decades in Japan as in other OECD countries, government statistics still show a sizable gap (see Figure 1). Furthermore, as Abe (2010) shows, much of the decline in the gender pay gap seems to have been caused by an increasing female enrollment in college and a rise in the recruitment of college-educated women by large firms following the enactment of Equal Employment Opportunity Act (EEOA) in 1986. The questions of why a significant pay difference between male and female workers with similar educational background and experience still remains, and whether those college-educated women are treated equal to their male peers remain unanswered. Although many prior works have emphasized segregation as an important source of the gender pay gap—e.g. women are more likely to work in low-wage industries (Blau and Kahn 2003), or as non-standard (or non-regular) workers (Houseman and Osawa 2003), this study focuses on intra-firm differences in pay between male and female employees who are otherwise comparable. Notwithstanding an obvious lack of external validity, our case study approach has a number of important advantages.

After the passage of the 1992 Child Care Leave Act, the 1999 Child Care and Family Care Leave Act, and its amendment in 2005 (CCLA hereafter), many large Japanese firms

introduced policies of parental leave and reduced work hours as options for working mothers.[1] The impact of this provision of parental leave on the gender wage gap is theoretically ambiguous. On the one hand, such a policy will encourage women to stay employed in the same firm, and their lifetime earnings should be greater than those who quit their jobs to stay home while raising their children. Furthermore, the firms may provide women with more training, knowing that a greater portion of female workers than before will remain on the job after childbirth (women will also increase their investment). On the other hand, the wage penalty for women who take longer parental leave may be substantially large. Women who would otherwise return to work following a short postnatal leave may be encouraged to take a longer parental leave by the new policy and miss opportunities for promotion and training, thus ending up with less important responsibilities with lower pay.

According to the National Fertility Survey conducted by the National Institute of Population and Social Security Research every five years, however, the share of women who maintain employment continuity through first childbirth has changed little, hovering around 36-40% for the past 25 years, implying that the CCLA has failed to encourage women to keep their jobs after first childbirth. Therefore, the above positive impact presumably did not

[1] Firms are legally required to offer parental leave until the child becomes one year old (one and a half if childcare service is not available), and one of the following until the child reaches the age of three: (1) reduced work hours; (2) flextime; (3) changes of start or ending time of work; (4) policy ensuring no overtime work; and (5) provision of childcare service in the workplace. Many large Japanese firms offer more generous policies such as parental leave until the child is three years old, or reduced work hours for the parents of preschool age children.

materialize.[2] There may be some socioeconomic factors that prevent Japanese women from benefiting from the legal protection (Edward 1988). Further study is necessary to evaluate the economic returns to employment continuity for Japanese women.[3]

One important feature of the post- CCLA work environment for women is that they have more choices about how long a period of leave they take for parenting, and how many hours they work while their children are small. It is plausible that this creates a signaling opportunity for women to show their commitment to work in general and their current employers in particular. Suppose the propensity to quit or remain on the job is private information, available only to the worker herself. Since women are much more likely to quit jobs than men at major life events such as marriage and childbirth, the employers may not want to train or assign important tasks to women. This is statistical discrimination, but employers will be willing to invest more in a woman if she can credibly demonstrate her commitment to work. Such signaling may take the form of working long hours, staying unmarried for many years, or returning to work after childbirth within a short period of time.

Our data are of a unique type, even compared with similar studies that use personnel data from one firm (for example, Ransom and Oaxaca 2005). The sample is from a large Japanese

[2] Hiroki Sato drew the attention of the authors to a recent study by the Cabinet Office showing that the share of regular female workers continuing their jobs over childbirth has increased from 40.4% in 1985-1989 to 52.9% in 2005-2009. This improvement was offset by declines for irregular workers and self-employed women who are not covered by the CCLA.

[3] Waldfogel (1997), using two young cohorts from the National Longitudinal Surveys of Young Women and of Youth (NLS-YW and NLSY), finds that women who were covered by a formal maternity leave policy and returned to their original employers after their most recent birth have higher current pay, all else equal, than other working mothers.

manufacturing company operating worldwide. Several features of the data are particularly appealing for an analysis of the mechanisms behind gender differences in pay and promotion. First, we have detailed information on job assignment that goes back to the year of hire for each employee and precise records on parental leave since 1999, when the firm's parental leave policy was introduced. This allows us to examine the maternity penalty on workers' pay and promotion, while controlling for various worker characteristics. Second, the data include information on hours worked that are quite useful to investigate their role in gender differences in promotion both as constraint and signaling. Third, unusually the data contain subjective measure of job performance (*jinji kouka*, or personnel appraisal) that is evaluated by direct superiors and used to determine a worker's bonus. The availability of such evaluation data allow us to provide rare evidence on the extent to which gender gap in pay and promotion are related to subjective evaluation of individual workers. Finally, the data includes the identifier of smallest organizational unit (often called *ka* [section]), team or group—typically 3-9 people for white-collar workers but up to around 90 people for blue-collar workers. This feature allows us to use only within-organization unit variation to identify gender differences, effectively ruling out the differences due to workplace segregation by gender.

In this study, we first scrutinize how much gender pay gap still exists within organizations after accounting for a number of human capital variables and other worker

characteristics. Next, we examine what factors are associated with the gender gap in pay and promotion speed and look for evidence of a maternity penalty and signaling behavior of female workers.

After providing a brief literature review in the next section, we describe the data and present descriptive statistics in section 3. In section 4 we outline our empirical strategy, and the main results are presented in section 5. Concluding remarks are offered in section 6.

2. Prior Literature

Several studies have attempted to evaluate the effect of career interruptions on women's subsequent wages (Mincer and Polachek 1974, Corcoran and Duncan 1979, Wellington 1992, etc.). They generally find that time out of work has a negative effect on wages, and attribute the gender pay gap to limited on-the-job training and rapid human capital depreciation due to career interruption for women. A natural interpretation of their results is that the dual responsibility of women, who bear more of the housework and childcare burden than men, helps to create the gender pay gap. Light and Ureta (1995) also demonstrate that the timing of work experience and time out matters, as well as accumulated work experience, by adopting a more flexible form of wage function than the traditional Mincerian one. According to their study, the 12% gender wage gap was due to differences in timing (i.e. differences in the

frequency, duration, and placement of nonwork spells) between men and women who have the same amount of work experience.

One problem with those earlier works is that they generally assume that the timing of childbearing and job separation, and the opportunities and actual selection of jobs, are treated as exogenous. It is quite possible that low wages for women induce job separation or planned job separation, and lead women to choose jobs with low skill intensity and minimal on-the-job training. Gronau (1988) attempts to trace the interrelationship among wages, planned separations, on-the-job training, and skill intensity of the job by estimating simultaneous equations. He finds that (1) low wages have a significant impact on job separation for men but not for women; (2) on-the-job training is sensitive to a worker's planned separation for men but not for women; and (3) job skill intensity is much less sensitive to a worker's experience and tenure for women than for men.

Meanwhile, several researchers started to pay attention to a potentially important role that signaling may play in determining the effect of time out on gender pay gap (e.g., Sundstrom and Stafford,1992 and Albrecht et al., 1998).. For example, using Swedish data, the latter has shown that the impact of time out (e.g. parental leave, household time out, unemployment, and others) have much stronger negative effects for men than for women even after accounting for individual fixed effects, private and public sector differences, and educational levels. They argue that the results are more consistent with a signaling

explanation than one based on human capital depreciation. One problem with their study is that they do not control for gender differences in the type of job. It is still possible that men are sorted into jobs where the returns to human capital are high (i.e. professional and managerial jobs) while women are sorted into jobs where the returns are low. The larger effect of time out for men may be reflecting a larger depreciation of human capital for men, rather than signaling.

Most early works on gender differences in promotion focus on documenting that promotion rates are lower for women than for men with similar observed characteristics (Cabral, Ferber, and Green 1981, Cannings 1988, Cobb-Clark 2001, Paulin and Mellor 1996, Pekkarinen and Vartianinen, 2004). Two competing explanations for such "unexplained" gender differences were proposed. First, there may be unobserved productivity differences or female preferences for different job characteristics (e.g. for less authority or fewer working hours required).[4] Such differences may be caused, for example, by a division of labor in the family, because married women are likely to allocate more effort to child care and housework, and to spend less effort on each hour of market work and seek less demanding work (Becker 1985). The second explanation attributes the differences to taste-based discrimination or statistical discrimination (Becker 1957, Phelps 1972, Arrow 1973, Lazear and Rosen 1990).

[4] The sociological literature emphasizes that the disadvantages associated with being in an occupation dominated by women persistently exists simply because bureaucratization and rationalization institutionalize the disadvantage in formal job description, job ladders, and patterns of pay progression. See Barnett, Baron, and Stuart (2000) for example,

A limited number of works attempt to determine which of the above two explanations better account for the differences (or four explanations, if we categorize them as productivity vs. job-related preferences vs. taste-based discrimination vs. statistical discrimination). Blau and DeVaro (2006), using the Multi-City Study of Urban Inequality, find that unexplained gender differences in the odds of promotion still remain even after accounting for job performance, occupation, and detailed firm characteristics. Their work reinforces the view that some form of discrimination may be at work behind the gender differences.

Some recent works are closely related to our study. Bertrand, Goldin and Katz (2010) find that the gender pay gap is associated with career interruptions due to parenting. Since their dataset consists of highly educated women (MBAs from a top school), career interruptions may be especially costly. In our study, we factored in hours worked in addition to parental leave history to evaluate how significantly the restriction on work hours matters for working mothers. Closest to our study is Gicheva (2010) who finds a positive relationship between hours worked and wage growth (and odds of promotion). She finds that this relationship is non-linear—for workers who put in 48 hours per week or more, working 5 extra hours per week increases annual wage growth by 1 percent, but when hours are less than 48, the average effect is zero. Gicheva also shows that working five extra hours per week increases the probability of receiving a promotion by more than 2.5%. Although she demonstrates that her finding is consistent with the learning-by-doing model with job ladders

and heterogeneous workers (in terms of ability and preferences for leisure), our results are at odds with the learning-by-doing model, as we show later.

3. Data

We collected personnel records from a large Japanese manufacturing company, which employs about 6,000 regular employees within Japan and, including affiliated firms, well over 20,000 employees worldwide.[5] Our dataset includes all domestic employees who were on the payroll in any time period during our observation between April, 2004 and March, 2010 and additional a few thousand workers temporarily transferred from the headquarters to affiliated firms. It is one of the first firms which participated in our industry-academic-government collaboration to create a personnel data depository. Our partner, Works Applications, Co. is a major ERP software package provider in Japan with approximately 300 listed firms in their user network. The Research Institute of Economy, Trade and Industry (RIETI), a think tank established by the Ministry of Economy, Trade, and Industry for policy-oriented research provided us with technical resources to store the data in a highly secure environment. In this project, almost all personnel records stored in the firm's human resource management system were deposited into RIETI's high-security server (with the exception of sensitive identity information such as names and addresses). Researchers

[5] Our confidentiality agreement with each firm prohibits us from revealing the name of the firm as well as further details on their product lines

analyze the data remotely using RIETI's virtual private network.

The dataset deposited by the firm consists of five major components: (1) employee characteristics; (2) pay and benefit records; (3) hours worked and absentee records; (4) evaluation records; and (5) announcement records for entry, separation, leave, transfers, and job re-assignment. It covers all domestic workers who ever worked for the firm's domestic establishments between FY2004 and FY2009.

Important employee characteristics available in the dataset include gender, date of birth, date of hire, nationality, education, and marital status among others. Marital status is constructed as a time-varying variable because the personnel records include the date of wedding or divorce. Although we do not have information on the number of children, we have data on the number of dependents. The number of dependents directly affects earnings because the firm pays dependent allowances. For married male employees, the number of dependents typically equals the number of minor and non-employed children plus one if the spouse is not employed. For married female workers, the number is usually zero if the spouse is employed and their children are reported as dependents to the spouse's employer. Therefore, the number of dependents might be a primary source of the asymmetric impact of marriage on the pay of men and women.

Although pay information is available from FY2004, part of our analyses needs to be restricted to the period between FY2005 and FY2009 because working hour information is

available only after FY2004. As shown below, it turns out that working hours play an important role in explaining the firm's gender gap in pay and promotion.

Evaluation records are available between FY2003 and FY2009. Employee performance was evaluated annually using a seven-point scale (SS, S, A1, A2, A3, B, C) until FY2007 and a five-point scale (SS, S, A, B, C) after FY2007. The company does not require supervisors to adhere to a certain pre-determined grade distribution. As such, supervisors tend to give the A grade (grades A1-A3 before the grading scale change) to their employees—about 80 percent of employees receive the A grade every year.

A major advantage of our dataset over many data used in the literature is the availability of the accurate job assignment history data that covers the entire employment period starting in the month of entry. In this paper we will take advantage of such unusual job assignment data, and define promotion with precision, which is our key career outcome variable. In addition, the job assignment data enable us to find who takes a parental leave and when, and most importantly when he/she returns from his/he parental leave. Finally, the job assignment data allow us to compare pay and promotion between men and women who are at the same job level in the same organizational unit.

4. Descriptive Statistics

We first describe employee composition by gender and marital status. Although, as we stated earlier, we do not have information about the number of children, we have the precise records of parental leaves since FY1999. Since pregnant women are entitled to maternity leave of fourteen weeks (eight weeks immediately after delivery is mandatory), we can utilize the incidence of maternity leave as an indicator of small children. Table 1 shows the composition of single/married men and women, and married women who took at least one parental leave since FY1999.[6]

As Table 1 shows, the share of female employees hovered around 11% during the period under observation, which is lower than the 16-18% average of large manufacturing firms with 1,000 employees or more according to Basic Survey on Wage Structure from the Ministry of Health, Labour and Welfare.

Table 2 summarizes a preliminary analysis of gender pay gap. Compared to married men, single men, single women, married women without small children, and married women with small children earn 28%, 36%, 32%, and 43% less, respectively. Since married men are 5-10 years older than the other groups on average, a substantial portion of the gaps should come from differences in human capital. Furthermore, women, especially those who are married

[6] We include a very small number of single women with small children in this category, for they will be subject to at least the same level of motherhood/ immobility penalty as married women with small children. In principle if a woman with small children is entering the firm, our definition of married women with small children will fail to count her unless she has another childbirth after entering the firm and hence take a mandatory maternity leave. Based on our interviews with the firm's HR managers, we are reasonably confident that our definition of married women with small children will capture most if not all of married women with small children at the firm.

and have small children, work substantially fewer hours than men. Single women, married women without small children, and married women with small children work 7%, 12%, and 22% fewer hours, respectively, than married men, while single men do not work significantly different hours than married men. Since we excluded records in the years when employees took at least one month of leave, low numbers for women with small children are not the result of parental leave. One relevant company policy that contributed to the observed difference is that women with children less than three years old can reduce their work hours to 6 hours per day. The provision of this policy or an equivalent substitute is required by the 2002 amendment of the 1992 Child Care and Family Care Leave Act.

In addition to differences in experience, we expect differences in education level to also contribute to the gender pay gap. Table 3 shows the changes in the distribution of education levels by gender over the past two decades. Surprisingly, due to a drastic shift in this firm's hiring policy in the 90s, the gender gap in educational background has narrowed substantially since then. In the 1990s, the share of college graduates (including those with graduate degrees) was 43% for men and 18% for women. In the 2000s, this gender gap reversed with the share becoming 52% for men and 59% for women. As the firm slashed administrative assistant jobs, it stopped hiring women with 2-year college degrees or less. Instead, it recruited more women with 4-year college degrees, master's degrees, and more women from vocational schools. The company also beefed up its hiring of medical technicians from

medical vocational schools as it expanded its line of healthcare products. Almost all men with high school diplomas are hired as production workers, and they are not expected to decline in number as drastically as women with similar educational background, unless the company decides to shut down many of its domestic plants.

As we will show later, the gender pay difference is smaller among younger workers mostly due to decreasing inequality in education level between men and women. This result is consistent with Abe (2010a), which finds that a substantial portion of the gender wage convergence is due to changes in the educational composition of the workforce and that the convergence is much smaller when the gap is calculated for each level of education.

The higher education level of women should naturally lead to an increase of women in upper-level jobs in the hierarchy. The firm has a job grade system where each job is assigned a specific job grade level based on an evaluation of the job content value. Each job grade level corresponds to a particular pay range according to which the total monthly salary is set for managers (50% of the monthly salary for non-managers). Therefore, moving up to a higher job grade level is associated with a discrete pay raise and announced as a promotion. Figure 2 illustrates the promotion ladders observed in the company. Solid lines indicate typical paths for those who get promoted and dotted lines represent atypical but not unusual cases of promotion. College graduates on the management track are first assigned to J1 but quickly move up to J2. Almost all members of this group move to SA and SB, and the

majority eventually move to the management ranks of G6 and up. Production workers start at the same level (J1) but more slowly climb to J2 and J3. Some highly talented blue-collar workers may be considered for managerial positions and they will be typically assigned to J4. Some of them may move up to the management track (e.g. SA, SB or G6) or get promoted to level GH, which is the level of foremen. Administrative support staff members who typically have high-school or two-year college degrees can move up to J2 and J3 levels, but it is extremely rare for them to get promoted to managerial positions.

Table 4 shows the distribution of the workforce across job grade levels, gender and marital status in FY2004 and FY2009. Since our dataset does not include employees who left the firm before FY2004, the precise employee composition can only be calculated for the period between FY2004 and FY2009. Although a higher percentage of women are observed in higher level positions in FY2009 than in FY2004, there are still few women in upper-level positions. For example, as of FY2009, only 3.4% of managers are filled by women. Among senior managers, only 19 (1.6%) are women. None of the women with small children are managers. Given that 11% of its workforce are women, this share of women in managerial positions is disproportionately low.

The low presence of women in upper levels of the hierarchy likely due to either slow promotion or high turnovers among women, or both. In order to investigate these possible causes, we first examine how the odds of promotion differ between men and women. Table 5

shows the frequency of promotion by gender and marital status. We compress the original 11 job grade levels (J1 to G3) to 8 levels in order to study the white-collar track and blue-collar track on a comparable scale. In this table, promotions from J2 to J3 for production workers and administrative assistants are not counted as promotions because these two job grades are combined as one job level in our analysis. High odds of promotion at the entry level J1 are not surprising because the company has a policy of assigning new college graduates to J1 and quickly move them all up to J2 after one year. Low odds of promotion from the J2/J3 level to the SA/J4 level are not surprising, either because many production workers and administrative support staff members with high school and 2-year college degrees are stuck at the J2/J3 level with no further promotions. Although talented production workers still have prospects of getting promoted to foremen or plant management positions, such a career track is very limited for female administrative assistants, who, as a result, show very low promotion rates at this level.

Although women have a higher promotion rate at the SA/J4 level than men, this advantage disappears once women reach the SB/JH level, and they continue to lag behind men. For example, although 17% of men at grade G5 get promoted to G4 every year on average, only 8% of women at the same grade get promoted in a similar manner. Since three quarters of women at G5 grade are married, this slow promotion of women may be associated with a constraint on work hours or lack of geographic mobility.

We next examine how separation rates differ between men and women over the life cycle. Figure 3 illustrates yearly separation rate separately by gender and marital status. Here, we define separation as a sum of voluntary quits and dismissals and do not include mandatory retirement, permanent transfer to affiliated firms, or death. As the figure shows, women, both single and married, face a much higher hazard of separation than men throughout the life cycle.

5 Empirical Strategy

There are two plausible explanations for the gender gap in promotion speed that are related but have slightly different empirical implications. First, female workers may get promoted less frequently simply because they have more stringent time constraints due to their expected roles in housework and providing childcare. According to the 2006 *Survey on Time use and Leisure Activities* in Japan, married men with children do only 10% of the housework and childcare, which is much lower than the comparable figures of 30-40 % in other developed countries. If this reflects the social norm governing the behavior of many couples, married women, especially those with small children, may well end up choosing to work shorter hours than their male peers. If leading a team or performing important responsibilities requires being flexible in work hours to respond to emergencies and solve

problems in a timely manner, those who cannot work beyond regular work hours will not be entrusted with such responsibilities. Such competing demands of work and family are especially intense when women have small children. As we mentioned earlier, according to the National Fertility Survey conducted by National Institute of Population and Social Security Research, 60-64% of women quit their jobs at the birth of their first child.

Additionally, married women with children suffer from the loss of human capital during the interruption caused by childbirth. Their general and firm-specific human capital will both become obsolete during the absence. Since the empirical implication for the loss of human capital is the same as the one implied by the time constraint explanation, we will not distinguish between the two.

Second, statistical discrimination may further affect those women who do not yet face competing demands of work and marriage (Phelps 1972, Arrow 1973, Lazear and Rosen 1990). Since women are more likely to quit at major life events such as marriage and childbirth, the expected return on training to the firm is lower for women. It follows that the firm assigns female employees jobs that provide fewer opportunities to accumulate human capital. Such a lack of human capital accumulation will result in poorer prospects for future promotion. Another implication of statistical discrimination is that signaling opportunities may be more valuable for women. Women who plan to stay at their current job may signal

their commitment by working long hours, staying unmarried, and (if married) taking shorter parental leave at childbirth.

Although these two explanations are not mutually exclusive or collectively exhaustive as reasons for the gender differences, they have testable implications. First, the competing demands explanation implies that the negative association between femaleness and pay and promotion should be substantially reduced once parental leave history and hours worked are accounted for. Second, the statistical discrimination explanation implies that women who work equally as hard as their male colleagues may still be given less training and fewer career opportunities because their expected probability of leaving the firm or showing less commitment in the future is higher. This implies that, due to asymmetric information regarding future possibilities, signaling may work more effectively for women—promotion decisions may be more correlated with observable effort measures such as hours worked. Women may also not be penalized (in fact, they might be rewarded) for bearing a child if they take a short parental leave to express their commitment to work. Third, the effect of competing demands and statistical discrimination will appear more strongly for those on the management track because the required human capital investment and worker commitment are higher. This means that the association of hours worked and parental leave history with worker pay and promotion probability should be more significant for college graduates than for those with less education.

In the section that follows, we first investigate the size of the gender pay gap. We begin with estimating the following Mincerian wage function using OLS:

$$\ln wage_{it} = X_{it}\beta + \gamma^1 Marriage_{it} + \gamma^2 Female_i + \gamma^3 Marriage_{it} \times Female_i + u_{it} \quad (1)$$

where the dependent variable $\ln wage_{it}$ is the logarithm of total pay for worker *i* in fiscal year *t*. Total pay is the sum of gross (before-tax) salary and bonus *Marriage* and *Female* are the indicators of being married and female, respectively, and X_{it} is the vector of other worker characteristics including age, tenure, and education level. In calculating tenure for those who have taken a long leave (more than one month) in the past, we subtract the period of leave from the total months of employment to account for the lack of human capital accumulation during leave. u_{it} is the error term and is likely to be correlated within worker and thus clustered standard errors are used to evaluate the results.

In estimating the gender differences in promotion, we estimate either ordered logit model or probit model with the following specifications:

$$Y_{it}^* = X_{it}\beta + \gamma^1 Marriage_{it} + \gamma^2 Female_i + \gamma^3 Marriage_{it} \times Female_i + u_{it} \quad (2)$$

where Y_{it}^* is the latent variable for either job grade levels (ordered logit model) or the incidence of promotion (probit model) for worker *i* in year *t*. u_{it} is the error term and follows logistic distribution (ordered logit model) or normal distribution (probit model) conditional on $(X_{it}, Marriage_i, Female_i)$. Again, it may be correlated within *i*.

When needed, we will test the robustness of the above baseline estimates by addressing a number of potentially serious econometric issues such as unobserved heterogeneity.

6 Results

6.1 Gender gap in pay

Table 6 shows the results of the OLS estimation of equation (1) using the entire sample. The baseline model in the first column is the most parsimonious specification controlling only for age and tenure. As expected, the gender pay gap is the largest with this model and indicates that unmarried women earn 17% less than unmarried men on average. Men enjoy a significant marriage bonus—married men earn 12% more than unmarried men—but women experience a marriage penalty of 6.5%. As such, the gender pay gap is found to widen as workers marry, resulting in a gender pay gap of 36 percent in total earnings.

Controlling for education reduces the gender pay gap only slightly (to 16% for unmarried and 31% for married workers). This is not too surprising, considering that women in this firm had as much education as men did in recent years (see the second column). A notable difference can be found between employees who graduated from technical colleges and those from two-year colleges. The former are public colleges that provide a five-year education in engineering for those who finish lower secondary school (middle school). Although graduates of technical colleges have two years less education than four-year college graduates, they are

treated almost equally as 4-year college graduates in terms of career path--most of them advance to management trainee positions (i.e. SA and SB). In contrast, two-year colleges provide liberal arts education to mostly women. Graduates of those junior colleges become administrative support staff and typically follow the same career path as female high school graduates, and rarely go beyond the J2 level. Only a few percent of them can switch to management trainee positions (e.g. SA and SB job grades). Including a set of educational level dummy variables allows us to account for the differing career implications of the above two groups with seemingly similar lengths of education.

One important fact that we should keep in mind is that the company has changed job design and pay systems a number of times since the Equal Employment Opportunity Act (EEOA) became first effective in FY1987 with the last major reform implemented in FY2003. The current job grade system was introduced the same year (FY2003). Assuming that the old system was more discriminatory against women and the switch to the new job grade system did not adjust the pay levels automatically for older employees who had entered the firm many years before, the pay differences between male and females workers are expected to be greater for older cohorts. In order to examine this prediction, we restrict our analysis to those who graduated after FY1986in the third column. As expected, the estimated gender pay gap is found to be 2-4 percentage points smaller for both the unmarried and the married after 1987.

In order to further investigate what factors are causing such a substantial gender pay gap, we repeated the same regression analysis adding one additional control variable in each step. Table 7 shows the results. Model 1 corresponds to column (1) in Table 7—accounting for only age (fourth degree polynomial), tenure (quadratic), and fiscal year dummies. Model 2 includes additionally controls for education (column (2) in Table 7).

Model 3 further controls for the number of dependents (in the logarithm) to capture both the direct effect on total earnings of dependent allowances as well as the indirect effect of having dependents. This dependent allowances that favor workers with dependents is reminiscent of the practices promoted by the government during wartime and is still prevalent among large Japanese firms. As we discussed earlier, the existence of dependent allowances directly increases both the marriage premium for men and the gender pay gap for the married because in most married couple it is the husband who claims the dependent(s).[7] Accounting for the number of dependents reduces the marriage premium for men and the gender pay gap for the married by 4-5%.

Model 4 additionally controls for job grade levels and job skill rank. Job grade levels are determined based on the actual job assigned to the worker whereas job skill rank is determined based on the supervisors' evaluation of the worker's skill level, which is part of

[7] Generally speaking, it is more beneficial to claim a dependent for tax exemption for whoever earns more. We believe that husbands typically claim it in part due to the fact that they are more likely to earn more than their spouses. The payment of dependent allowance is based on the information on the tax documents.

the annual evaluation. Since job grades and job skill ranks are two of the most important determinants of salary and bonus, adding the two has improved the R squared considerably from 0.7766 to 0.9182, and reduced the gender pay gap substantially—by 8% and 9% for the unmarried and the married, respectively. This means that a substantial part of the gender pay gap is caused by slow promotion to higher job grade levels or differential job assignments for female workers.[8]

In the next model, we additionally account for hours worked per year (*hours*), annual reduced work hours (*jitan* meaning reduced hours in Japanese, arranged for employees with needs to take care of their pre-elementary school age children), and annual late night hours worked (*yakan* meaning night time in Japanese). The reason for including three variables is that the implications for evaluation and promotion decisions may differ as well as different rates that apply to ordinary overtime work, reduced work, and work during the night-time shift. Note that the late night hours worked may also capture the different nature of job contents. For example, both production workers and administrative support staff move up the non-managerial track but the gender composition is strikingly different between production workers and administrative support staff as the former is predominated by men and the latter by women. Monthly salary could be significantly different between them due to differences

[8] Skill rank is highly correlated with seniority and largely irrelevant to managerial track workers. Reassuringly it is found to be largely job grade not skill rank that matters for earnings and promotion for college graduates. These results as well as all other unreported results are available upon request from the corresponding author.

in benefits and premium pay for off-hour shifts for production workers. Surprisingly, accounting for working hour variables almost eliminated the remaining unaccounted gender pay gap. Now, the unaccounted pay gaps are only 0.3% (statistically insignificant) for the unmarried and 3.5% for the married. Further controlling for evaluation (Model 6) does not help to explain the gender pay gap.[9]

We also repeat the same exercise restricting our sample to only college graduates (we do not include those with graduate degrees). Note that, in Model 2, we attempt to account for some differences in worker human capital by including a university ranking category variable.[10] Similar to the result for the whole sample, the unaccounted gender pay gaps shrink to 1.3% and 3.6% for the unmarried and the married, respectively, once job grade, job skill ranks, and working hour variables are controlled for.

To sum up, most of the gender pay gap seems to be related directly or indirectly to shorter hours worked and the slow promotion of female workers (job grade levels). Roughly speaking, the twenty five to fifty percent of the gender pay gap that typical human capital

[9] Our conclusion that evaluation does not account for the gender pay gap remain valid when we change the order of adding evaluation and hours variables--add evaluation before the hours variables.

[10] Building on one of the most widely used university ranking in Japan--the Yoyogi-seminar's university ranking (http://www.yozemi.ac.jp/rank/gakubu/index.html), we constructed a category variable where 1 indicates the 1st-tier national universities (Tokyo, Kyoto, Hitotsubashi, Osaka, Tokyo Institute of Technology, Tokyo University of Foreign Studies), 2 indicates the 2nd-tier national universities (Nagoya, Kobe, Tsukuba, Kyushu, Hokkaido, Tohoku, Ochanomizu, Yokohama National), 3 indicates the 1st-tier private universities (Keio, Waseda, Sophia, ICU), 4 indicates the 2nd-tier private universities (Gakushuin, Meiji, Aoyama Gakuin, Rikkyo, Chuo, Hosei, Tokyo University of Science, Doshisha, Ritsumeikan, Kansai Gakuin, Kansai, University of Occupational and Environmental Health), and 5 indicates all other universities.

variables (i.e. education, experience, tenure) cannot explain can be attributed to either factor. For the remainder of the paper we will explore these two major culprits for the gender pay gap and provide further insights on the gender gap in labor market outcomes.

6.2 How large is the maternity penalty?

Working hour variables account for thirteen percentage points of the gender pay gap for the married. It is quite plausible that career interruptions or restrictions on work hours due to childbirth and parenting are causing this link.

Table 8 summarizes the records of parental or family care leave taken between 1999 and 2009 by those in the sample. The company records do not distinguish between parental leave and family care leave (mostly to care for the elderly). For women, however, mandatory postnatal leave, which is differently coded due to the different funding source for the benefit, always precedes parental leave. Therefore, we can surmise which leave is for parenting and which is for other family members. There are two remarkable points to note about the summary table. First, although we do not know the parental vs. family care leave composition in the fourteen male cases, it is clear that few men take parental leave despite the fact that men are equally eligible for parental leave.[11] We suspect that social norms may be still working against men who take parental leave in Japan (Fortin 2005). Second, the average

[11] What is uniquely generous about the Japanese system is that both mother and father can take parental leave at the same time.

period of leave for women is fourteen months, although the actual leave varies widely from two months to over two years. Third, a majority of women who have taken a leave don't have four-year college degrees, because the company did not hire female college graduates for management trainee positions until the 2000s.

In order to evaluate the impact of career interruptions or restrictions on work hours due to childbirth and parenting, we estimate OLS and fixed effect models similar to equation (1) including variables summarizing parental leave history and hours worked. *births* is a category variable indicating the number of prenatal/postnatal leave spells that each worker took in the past and can be interpreted as the number of childbirths since 1999. Since there are only seven cases of more than two childbirths, we combine cases of two or more spells as *births* = 2. The variable takes zero for all men. *leave_pd* is the accumulated length of leave (prenatal, postnatal, parental and family care leave). We also add variables for the three types of hours worked: hours worked per year (*hours*), reduced work hours (*jitan*) and night-time hours worked (*yakan*) in the logarithm form.

Table 9 shows the results for all employees and a subsample of college graduates. Compared with the second column of Table 7, the coefficients *Marriage* × *Female* are substantially smaller in Column 1 and 2 of Table 9, indicating that some portion of the gender pay gap estimated earlier in fact reflects the impact of career interruptions or restrictions on work hours due to childbirth and parenting. More precisely, the gender pay gap for the

married was reduced from 31% to 26% after accounting for parental leave history and further down to 18% after controlling for working hour variables. For the subsample of college graduate workers, the role of childbirth and parenting may be much smaller because a substantially smaller portion of this group have taken a parental leave. The gender pay gap for the married in this subsample declined slightly from 21% (see Model 2 in the bottom of Table 7) to 19% and 16% after accounting for leave history and hours worked, respectively.

The OLS estimates on the wage effects of the incidence of maternity leave and its lengths do not appear to point to any clear conclusion. When the hours variables are not controlled for, the estimated coefficients on leave_pd for both samples are negative and significant, pointing to a wage penalty for those who do not return quickly to work from their maternity leaves. However, once the hours worked are accounted for, the estimated coefficients on leave_pd are no longer significant for either sample

However, leave_pd may be affected by unobserved worker characteristics, and if such unobserved worker characteristics are correlated with wages, the estimated coefficients on leave_pd will be biased. For instance, if the female employee with high innate ability is more likely to have a husband with more demanding and high-paying jobs, she is more likely to take a longer parental leave. If we fail to control for such innate ability of the female employee, any negative wage effect of leave_pd will be offset by the positive wage effect of her high innate ability. In other words, once we use individual fixed effects to control for such

time-invariant worker heterogeneity, we are likely to find the negative wage effect of leave_pd.

Table 10 shows such fixed effect estimates (along with the OLS estimates). As expected, the negative wage effect of leave_pd is underestimated in OLS (in fact, it is not significantly different from zero). However, once unobserved worker heterogeneity is accounted for by using individual fixed effects, the estimated coefficients on leave_pd are negative and significantly different from zero. The fixed effect estimates provide several insights on the role of maternity leave and working hours in the gender pay gap. First, we find a non-linear maternity penalty. Namely, the decline in wage income is not proportional to the length of the time out. The coefficient of the indicator of births=1 is significantly positive in the fixed effect models for women (Column 2 and 3). According to the estimation result in Column 3, a female worker who gives birth will not experience any decline in income as long as she comes back from leave within seven months and works for the same hours as before. However, as she delays her return from her maternity beyond seven months, there will be a maternity penalty (wage decline) and the size of the maternity penalty will continue to increase as she keeps delaying her return.

Second, the estimated coefficients on *leave_pd* are much smaller once hours worked is accounted for. This indicates that a much larger portion of the maternity penalty can be attributed to the restrictions on work hours after returning from leave rather than the leave

itself. You can see this picture in the top portion of Table 12 where we calculated the impact of time out on total pay for the average female worker. If a female worker takes twelve months of leave at her first childbirth, she is likely to lose 17% of income after coming back to work but most of the income drop will be due to shorter hours worked and the use of the reduced work hour benefit for working mothers.

Third, by comparing the impacts of time out between women and men, we see that time out is more detrimental for men than for women. Men typically lose 7-11% of their income after taking only a three month leave depending on whether their hours worked afterwards are affected or not. This finding is consistent with Albrecht et al. (1998) who found a similar result using Swedish data. The plausible explanation is that since taking leave is so unusual for men in Japanese firms, doing so has a very negative signaling effect—superiors interpret the action as signaling the person's low commitment to work.

Table 11 presents the results of the same analyses for a subsample of college graduates. The coefficients clearly indicate that the maternity penalty is much greater for college graduate women. For this group, even those who return right after the minimum two months of mandatory postnatal leave suffer income loss on average (Column 2) although this effect is somewhat muted when hours worked are controlled for. Since there are only a few female college graduates who have taken maternity leave twice in the dataset, the dummy variable for *births=2* was dropped in some specifications.

We find two sharp contrasts between our whole sample analysis and the college graduate sample analysis: (1) the maternity penalty does not decline even after accounting for hours worked; and (2) the maternity penalty is not greater for men any more. The bottom rows of Table 12 clearly show that those educated women suffer 20% of loss in income per year of parental leave and shorter hours worked do not seem to be associated with the maternity penalty. We speculate that jobs for college graduates are most affected by technological development and relation-specific knowledge, and thus that the depreciation of their human capital is faster. Therefore, their positions may be more likely to be assumed by somebody else when they return from parental leave, and they might lose substantial task-specific human capital.

A substantial maternity penalty for female college graduates is also explained by their career track change before and after their maternity leave. Our interviews with HR managers indicated that jobs or career tracks are heterogeneous, and not all female college graduates are in management trainee positions. Suppose there are high wage growth jobs and low wage growth jobs. The former requires a high commitment and includes a possibility of relocation. Thus, many pregnant women or those with small children in the former group may change their jobs from a high commitment/wage growth job to a low commitment/wage growth job. Since this kind of job change is also associated with longer parental leave, the estimated maternity penalty increases.

Whatever the explanation, our result is consistent with Bertrand, Goldin and Katz (2010) who found that the gender pay gap is associated with career interruptions due to parenting. Since their dataset consists of highly educated women (MBAs from a top school), career interruptions may be especially costly.

In sum, the incidence of childbirth and the choice of parental leave periods could affect the observed wage levels through multiple channels. First, having a small child will lead to fewer hours worked due to the competing demand of childcare. Second, the expectation of fewer work hours and a weaker commitment, or a demonstration of a high commitment through the choice of a shorter leave period may result in a change in job assignment to one with less or more responsibility. Such a job change would not only be preferred by the firm but also may be favored by the worker herself, who needs to balance dual responsibilities. The provision of training may also change accordingly. Third, the different costs of childbearing and career interruption by career tracks will affect the initial choice of job and the timing of childbearing, which in turn affects our estimation of the impact of childbirth on wage income.

The purpose of including hours worked as a control is to distinguish the effect of reduced hours on wage from the effects through career track selection. The substantial difference between the entire sample and the subsample of college graduate women seems to suggest that the above impact of time away is predominantly caused by the first channel for less

educated women while the career track selection is much more important for highly educated women.

6.3 The Gender Gap in Promotion

Table 13 shows the results from our initial analysis of the gender gap in promotion using an ordered logit model estimation of job grade levels. Consistent with our results of the OLS estimation of wage function, job grade levels are consistently found to be negatively correlated with femaleness after accounting for education and experience, and the gender gap is greater for the married. The results are robust to the inclusion of leave history variables and evaluation grades and the restriction to college graduates. For our analysis using the subsample of college graduates, we account for school quality by including the university ranking category variable as a control.

One important finding in this table is that women who receive the highest evaluation are no significantly more likely to get promoted than those who receive an average evaluation. Thus, while the estimated coefficient on A1 or better is positive and significant, the estimated coefficient on the interaction term involving female and A1 or better is negative and significant, almost completely offsetting the positive coefficient on A1 or better. It follows that getting better evaluation will help male employees get promoted whereas getting better

evaluation has no beneficial effect for promotion of female employees. It other words, women face a glass ceiling or are in jobs with no prospects for promotion.

Promotion is likely to take place progressively from the bottom of the promotion ladder to the level next to the bottom and so force. To capture such a promotion ladder more accurately and investigate the mechanism behind the slow promotion of female workers, we evaluate the impact of parental leave and hours worked on the probability of promotion conditional on the current job level using a Probit model.

$$\begin{aligned} Prom_{it}^{*} = \tilde{X}_{it}\beta + \lambda^{1} \ln Hours_{it-1} + \lambda^{2} \ln Hours_{it-1} \times Female_{i} + \gamma^{1} Marriage_{it} \\ + \gamma^{2} Female_{i} + \gamma^{3} Marriage_{it} \times Female_{i} + u_{it} \end{aligned} \quad (4)$$

where $Prom_{it}^{*}$ is the latent variable in the Probit model for the binary outcome $Prom_{it}$ which is a dummy variable indicating the promotion to a higher job grade. u_{it} is the error term that may be correlated within *i*. Thus, we use clustered standard errors to evaluate the significance of coefficients. Note that we include the interaction between *Female* and ln*Hours* to account for the possibility that hours worked may be more important for women as signals of their commitment to work.

Table 14 shows the results for the entire sample and the subsample of college graduates. *births* = 2 (i.e. incidence of having two or more childbirths) is dropped because very few females workers who took maternity leave twice got promoted. Although the coefficients for *Female* in all model specifications are negative, their magnitude is augmented by the inclusion of the interactive term between *Female* and lagged ln*Hours*, which always has a

positive coefficient. Note that the coefficients on one maternity leave spell (*birth=1*) and accumulated length of leave (*leave_pd*) are negative as expected although neither is significant (Column 1). The coefficient of *leave_pd* is reduced substantially but becomes significant after working hour variables are controlled for (Column 2). This implies that childbirth delays the promotion of female workers through two channels—career interruption itself and a reduction in work hours after returning from the leave. Adding evaluation grades as a control does not change the overall picture (Column 3). We also see a similar pattern for college graduates (Column 4-6)

The positive and significant coefficient of *Female* × lagged ln*Hours* in all specifications clearly indicates that hours worked plays a more important role in the promotion decisions for women than for men. The relationship between hours worked and the odds of promotion may not be linear. Using the U.S. National Longitudinal Survey of Youth, Gicheva (2010) finds that the relationship between hours worked and wage growth is non-linear—only workers who put forth more hours than a certain threshold see the positive impact of working additional hours. To investigate such possible non-linearity, we re-estimate the model in equation (4) replacing $\ln Hours_{it-1}$ with a categorical variable $Hours\_cat_{it-1}$ which takes 1 if hours worked is less than 1800 hours per year; 2 if it is 1800 or more but less than 1900, 3 if it is 1900 or more but less than 2000, 4 if it is 2000 or more but less than 2100, 5 if it is

2100 or more but less than 2200, 6 if it is 2200 or more but less than 2400, and 7 if it is 2400 hours or more.

Figure 4 illustrates the predicted odds of promotion for each categorical value of $Hours\_cat_{it-1}$ averaged over subsamples of men and women (4-1) and averaged over the subsamples of college graduate men and women (4-2). They imply that, for men, working extra hours affect the odds of promotion only when hours worked exceed 2200 hours per year but, for college graduate men, hours worked do not seem to affect the odds of promotion. For women, there is much stronger relationship between the two in every level of hours worked but the impact of working extra hours is especially strong when hours worked exceed 2200 hours per year. What is interesting is that, except for the group of employees who work less than 1800 hours, women who work the same hours as men have higher odds of promotion than men. Although we are not comparing men and women with the same characteristics in Figure 4 (i.e. averaged separately over subsamples), comparing men and women with the same characteristics (i.e. averaged over the entire sample at female=[0,1]) does produce the same pattern.

This contrast between men and women may imply that the revealed preference for long work hours does not affect the perceived competence of male college graduates but does so for female college graduates. Note that working long hours could be associated with a worker's commitment to work, the assignment of challenging tasks, or low productivity.

Therefore, we do not have an a priori expectation about how hours worked should be associated with promotion probability. It is plausible however, that by working longer, a female worker can credibly signal her commitment to work and demonstrate that her competing demands of housework and childcare do not affect her performance.

Another possibility is that the stark difference between men and women in the association of longer hours with promotion the following year may be simply reflecting job segregation. Many authors, including Blau and Kahn (2000) have reported that women were concentrated in administrative support and service occupations.[12] Some college-educated women may be assigned to jobs with little training and promotion prospects while others join college-educated men in management trainee jobs. If women in the former group have no reasonable promotion prospects, they will not work long hours. Combining members from the two groups may result in a high correlation between the odds of promotion and hours worked.

We can eliminate the bias caused by job segregation to the extent to which good jobs and bad jobs are separated into different organizational units by estimating the model with organizational unit fixed effects. A typical organization unit is a section of 3-9 people for white-collar workers and a group of people working on the same production line or support

[12] Historically in Japan, women were typically assigned to administrative support and clerical jobs called *ippan-shoku* (general job), while college educated men were assigned to management trainee positions called *sogo-shoku* (composite job). Although such differentiation was prohibited by the EEOA, a similar pattern of task assignment may still remain.

function (up to 90) for blue-collar workers. We employ a conditional (fixed effects) logit model. Note that we have a set of workers (i = 1,2,…,n) who are grouped into organizational units (j = 1,2,…,J). Consider the following logistic regression model:

$$\log(\frac{p_{ijt}}{1-p_{ijt}}) = \mu_i + \beta X_{ijt} + \alpha_i$$

where p_{ijt} is the probability that worker i in group j gets promoted in period t, μ_t is the intercept that may be different for each period t, X_{ijt} is a vector of predictors that may vary across workers or across time, and α_i represents the combined effects of all unobserved characteristics of each organizational unit. It is well-known that the log likelihood function for this logistic regression model, conditional on the number of promotions within the same organizational unit being the actual number observed, does not contain α_i and the coefficients of Maximum Likelihood Estimation is consistent.

The results of this conditional (fixed effects) logit model presented in Table 15 are qualitatively almost identical with the probit model estimation results in Table 14 except that for college educated women the maternity penalty is significant and much more distinct but taking long parental leave is not necessarily detrimental. A comparison between the probit estimation and fixed effects logit estimation presents several implications. First, the high correlation between the odds of promotion and hours worked among women is not driven by the fact that women who are assigned to workplaces with good promotion prospects work longer hours. The same result is obtained even when we focus on the variation within

organizational units. Second, longer hours worked are now negatively correlated with odds of promotion for men, although this result does not hold when the sample is restricted to college graduates. This result suggests that, at least for lower skilled workers, longer hours signal low productivity when two employees working side by side are compared. Third, the earlier finding that women who take longer parental leaves receive lower earnings in the future primarily comes from the variation across organizational units. Hence, it may be the case that women who are in jobs with less training and less promotion prospects are more likely to take longer parental leaves. This result must be interpreted with caution, however, because it is quite possible that those who take longer parental leaves may be transferred to jobs with little promotion prospects after returning to work (thus within organizational unit variation does not affect the odds of promotion).

6.4 Gender Gap in Evaluation

Finally, we estimate the ordered logit model using the employee's evaluation as the dependent variable to see if there are any gender differences in evaluation that cannot be accounted for by other variables. Table 16 presents the results. Job grades are controlled for because the company's "management by objectives" policy requires the evaluator and the

evaluated to set objectives in accordance with performance standards and level of responsibilities expected for the job grade level.

Although evaluation grades are positively associated with education, they are negatively associated with many variables that are known to be positively correlated with wage and promotion, such as marriage and hours worked. Although unmarried women tend to receive lower evaluations than unmarried men, married women tend to obtain no worse evaluations than married men. These results may be consistent with the statistical discrimination explanation. Unmarried women receive less training because there is a greater uncertainty about their commitment, but such discrimination disappears after they stay at their jobs after marriage and show commitment over time. But this explanation does not explain why married men receive lower grades. One plausible explanation is that the company's evaluation mainly measures job-specific or task-specific human capital. Workers who are more likely to get promoted (e.g. married men, those who work long hours, etc.) have been on a specific job for a shorter amount of time and have accumulated less task-specific human capital and thus receive lower evaluation grades. On the other hand, workers who have been on the same job for a long time (e.g. married women with small children choosing reduced work hours) have accumulated a lot of task-specific human capital, and thus receive relatively higher grades.

This interpretation is consistent with institutional details on how the evaluation system is designed. The company employs “management by objectives” and therefore, good evaluations indicate that the employee achieved many of his/her objectives for the year. The evaluator does not evaluate the worker’s competency as a manager nor are the evaluation results used directly for promotion. Therefore, the variable purely measures the job-specific and task-specific performance and mainly affects the bonus amount in the following year. Overall, we find little evidence that evaluation is a main driver of the gender gap in pay and promotion (this is particularly true for college graduates).

7 Conclusion

The gender pay gap is a persistent nature of every country’s labor market (Blau 2003) and it is especially large and tenacious in the Japanese labor market. This gender gap may be caused by the actual and expected human capital loss due to career interruptions, as well as different jobs and skills men and women choose to acquire. Using detailed personnel records from a large Japanese manufacturing firm, we have attempted to identify the sources of the large intra-firm gender gap observed in the firm. We find 19% and 28% gender pay differences among unmarried employees and married ones, respectively, after controlling for basic human capital variables. The gender gap declines substantially when accounting for job levels and hours worked. The unaccounted portion of the gender pay gap is likely to be

mostly caused by differences in unobserved job contents. When we restrict our analysis to college graduate employees, the gender pay gap is only a few percentage points once job levels and hours worked are controlled for. As such, most of the gender pay gap among employees on the management track is caused by fewer hours worked and slower promotion among women.

As primary mechanisms behind the slow promotion of women, we have sought evidence on two theories explained by the competing demands of housework/childcare, and statistical discrimination. The data generally have supported the competing demands explanation. A substantial component of the gender gap in pay and promotion for married workers is explained by shorter hours worked and parental leave history. Furthermore, our probit analysis of promotion has revealed that lagged hours worked is the most important predictor of the gap, together with evaluation grades.

We have also found some evidence for statistical discrimination. First, the maternity penalty is non-linear. Female workers who return to work after a short parental leave is subject to no maternity penalty, but taking a long parental leave or having two childbirths results in a significant loss in income and a much lower chance of promotion thereafter. Women may effectively signal their commitment to work by returning from parental leave within six months. Second, the promotion of female workers is much more strongly correlated with hours worked in the previous year. This finding may indicate that women can

ease the concerns of their superiors about their commitment to work by working longer hours, but such signaling is not necessary for men. Furthermore, such correlation between promotion and lagged hours worked is lower and insignificant for male college graduates whereas it is even higher in the case of women. It may be the case that the required human capital investment is higher for management trainees, and thus signaling private information regarding commitment and the competing demands of housework is more important for college educated women.

Our findings are different from Gicheva (2010) who reports that the slope of the relationship between hours worked and wage growth differs little between men and women, whereas they are quite different in our study. What is striking in our findings is that the slope is very flat for men but it is significantly steep for women. The learning-by-doing model used in Gicheva (2010) cannot explain our results.

Although we interpret the high correlation between long hours worked and odds of promotion as indicating evidence of signaling, we actually do not know whether the long hours worked are due to the employee's choice or to the employer's job assignment decision. For example, there are at least two more possible interpretations, both of which depict the situation caused by asymmetric information.

First, as discussed in Landers, Rebitzer, and Taylor (1996), the firm may impose the "overwork" norm and use the information of each worker's hours to sort out workers with a

high propensity to work hard when making decisions on promotion. This interpretation is close to the idea of rat-race equilibrium first proposed by Akerlof (1976).

The second interpretation is in line with Prendergast (1992) who studied situations where the employer has private information about worker ability. Namely, a manager who identifies a capable woman would assign her a challenging task to credibly signal her positive prospect. Such signaling may be desirable if most women are discouraged and are not willing to work long hours due to their perception that women are discriminated against. On the other hand, if men are generally committed to work, equal treatment may be desirable because providing more training (i.e. by assignment a challenging task) to a small number of selected men may discourage other male workers. In other words, both separation and pooling may arise as equilibria for women and men, respectively. In this interpretation, the causality is in the opposite direction—a female worker who has better promotion prospects works long hours.

In future work, we plan to examine which of these three theories best fits our data.

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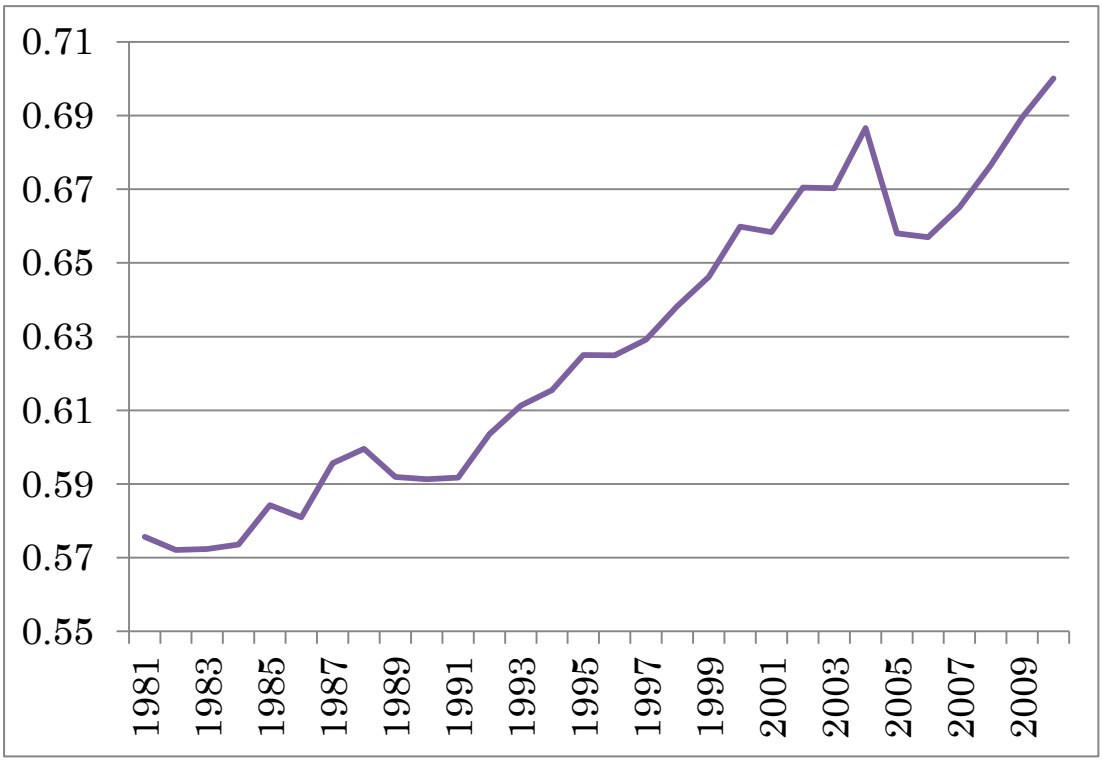
Figure 1 Gender Pay Gap Measured by Hourly Wage in Japan.



Note: Based on the Basic Survey of Wage Structure by MHLW.

Table 1 Employee Composition by Gender and Marital Status

Fiscal Year	Single Men	Married Men	Single Women	Married Women without Small Children	Married Women with Small Children*	Total
2004	18.6%	70.6%	5.9%	4.4%	0.6%	100%
2005	19.3%	69.8%	5.5%	4.2%	1.2%	100%
2006	21.6%	67.5%	5.5%	3.8%	1.6%	100%
2007	23.2%	65.6%	5.8%	3.6%	1.8%	100%
2008	25.5%	63.4%	5.5%	3.5%	2.0%	100%
2009	25.8%	63.0%	5.5%	3.5%	2.2%	100%

Note: Includes only regular workers. * shows the number of female workers who have taken parental leave after FY1998. This group also includes those who got divorced after having children.

Table 2 Annual Wage, Average Age, Hours Worked by Gender and Marital Status

Average Annual Wage

Fiscal Year	Single Men	Married Men	Single Women	Married Women without Small Children	Married Women with Small Children*
2005	5,900,233	8,087,088	5,222,444	5,157,902	4,403,632
2006	5,961,231	8,198,714	5,402,587	5,405,735	4,471,967
2007	5,922,937	8,265,332	5,582,436	5,763,785	4,839,741
2008	5,803,538	8,186,499	5,469,831	5,811,252	4,825,612
2009	5,275,211	7,570,200	5,057,443	5,437,273	4,560,014
Average	5,772,630	8,061,567	5,346,948	5,515,189	4,620,193

Average Age

Fiscal Year	Single Men	Married Men	Single Women	Married Women without Small Children	Married Women with Small Children*
2005	34.9	44.4	37.3	36.7	34.8
2006	34.7	44.3	37.9	37.6	35.0
2007	34.0	43.9	38.0	38.9	36.2
2008	33.3	43.4	37.7	39.9	36.5
2009	32.9	43.1	38.2	40.4	37.4
Average	33.9	43.8	37.8	38.7	36.0

Average Hours Worked per Year

Fiscal Year	Single Men	Married Men	Single Women	Married Women without Small Children	Married Women with Small Children*
2005	2,072	2,060	1,922	1,794	1,667
2006	2,090	2,073	1,945	1,821	1,640
2007	2,095	2,091	1,950	1,838	1,588
2008	2,112	2,089	1,919	1,821	1,613
2009	2,059	2,034	1,854	1,782	1,588
Average	2,086	2,069	1,918	1,811	1,619

Note: The figures in the table only include those who work for twelve months in each fiscal year. Hence, women who took a parental leave in the fiscal year are not included.

Table 3 Distribution of Men and Women by Education levels

Men

Year of Hiring	Ph.D.	Master	BS/BA	Tech. College	2-yr. college	Vocatio-nal Sch.	High School	Middle School	UNK	Total
1990-99	1.8%	18.5%	23.0%	7.2%	0.7%	3.7%	44.2%	0.8%	0.1%	100.0%
2000-09	3.8%	19.7%	28.5%	3.2%	0.9%	5.0%	30.6%	0.2%	8.0%	100.0%

Women

Year of Hiring	Ph.D.	Master	College	College of Tech.	2-y college	Vocation al Sch.	High School	Middle School	UNK	Total
1990-99	0.3%	3.3%	14.8%	1.3%	37.2%	9.5%	33.4%	0.0%	0.3%	100.0%
2000-09	4.2%	26.7%	28.3%	3.3%	3.6%	20.2%	5.5%	0.0%	8.1%	100.0%

Note: Employees hired before 2004 include only those who were still employed in 2004. UNK stands for unknown.

Figure 2 Promotion Path Chart

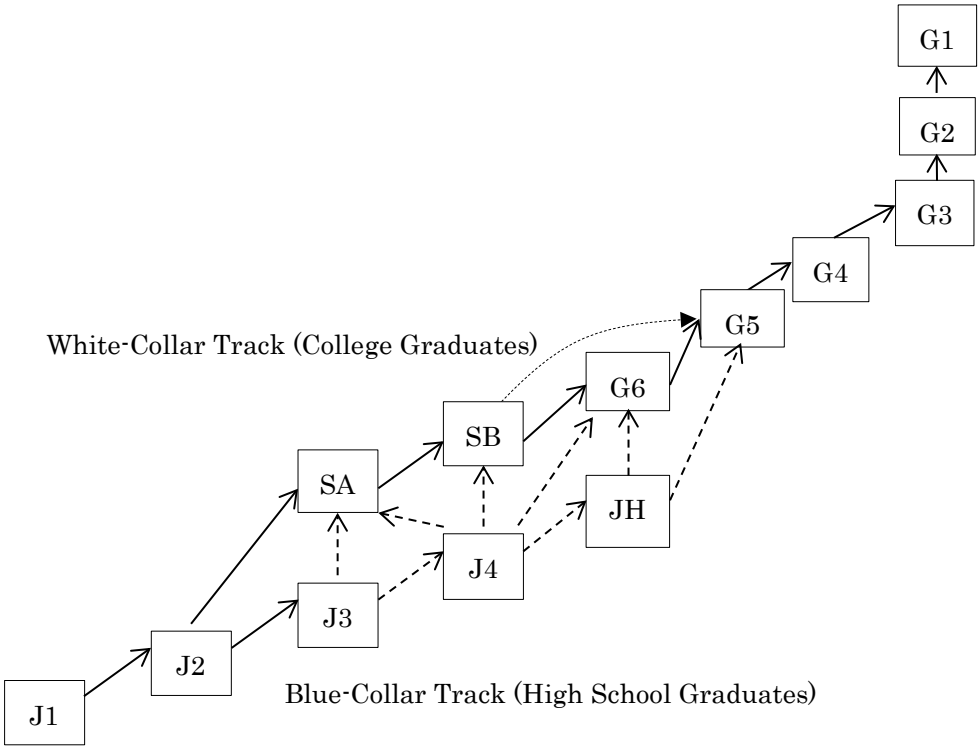


Table 4 Distribution of Men and Women in Hierarchy

As of 2004

Job Grades	Single Men	Married Men	Single Women	Married Women without Small Children	Married Women with Small Children*	Total
J1	3.09%	1.77%	0.30%	0.08%	0.00%	5.24%
J2, J3	8.88%	27.73%	4.89%	3.63%	0.57%	45.68%
SA, J4	2.29%	8.64%	0.31%	0.11%	0.01%	11.37%
SB, JH	1.54%	4.56%	0.11%	0.11%	0.00%	6.33%
G6	1.10%	4.04%	0.13%	0.25%	0.03%	5.55%
G5	1.22%	10.61%	0.14%	0.17%	0.00%	12.14%
G4	0.44%	8.71%	0.03%	0.08%	0.00%	9.26%
G3	0.08%	3.53%	0.01%	0.00%	0.00%	3.63%
G1,G2	0.01%	0.79%	0.00%	0.00%	0.00%	0.81%
Total	18.66%	70.36%	5.92%	4.45%	0.61%	100.00%
Managers	202	1,954	22	36	2	2,216
(G6 or higher)	9.1%	88.2%	1.0%	1.6%	0.1%	100.0%
Senior Managers	38	920	3	6	0	967
(G4 or higher)	3.9%	95.1%	0.3%	0.6%	0.0%	100.0%

As of 2009

Job Level	Single Men	Married Men	Single Women	Married Women without Small Children	Married Women with Small Children*	Total
J1	6.91%	3.04%	0.59%	0.11%	0.01%	10.63%
J2, J3	8.77%	20.65%	3.36%	2.32%	1.78%	36.85%
SA, J4	4.94%	8.17%	0.93%	0.37%	0.10%	14.52%
SB, JH	2.45%	4.84%	0.32%	0.17%	0.15%	7.93%
G6	0.92%	4.06%	0.13%	0.15%	0.15%	5.42%
G5	1.15%	8.07%	0.14%	0.18%	0.04%	9.58%
G4	0.64%	9.51%	0.08%	0.13%	0.00%	10.34%
G3	0.11%	3.81%	0.00%	0.04%	0.00%	3.96%
G1,G2	0.01%	0.77%	0.00%	0.00%	0.00%	0.78%
Total	25.91%	62.92%	5.54%	3.47%	2.23%	100.00%
Managers	222	2,053	27	39	15	2,355
(G6 or higher)	9.4%	87.2%	1.1%	1.7%	0.6%	100.0%
Senior Managers	60	1,103	6	13	0	1,181
(G4 or higher)	5.1%	93.4%	0.5%	1.1%	0.0%	100.0%

Table 5 Frequency of Promotion by job level, gender, and marital status (2004-2009)

	Single Men			Married Men			Men Total		
Job Grades	# of employees	Freq. of promotions	Promotion rate	# of employees	Freq. of promotions	Promotion rate	# of employees	Freq. of promotions	Promotion rate
J1	2646	696	26.3%	1241	277	22.3%	3887	973	25.0%
J2, J3	3746	136	3.6%	10495	515	4.9%	14241	651	4.6%
SA, J4	1483	227	15.3%	3721	242	6.5%	5204	469	9.0%
SB, JH	830	103	12.4%	2024	265	13.1%	2854	368	12.9%
G6	436	65	14.9%	1669	298	17.9%	2105	363	17.2%
G5	559	41	7.3%	4146	485	11.7%	4705	526	11.2%
G4	238	12	5.0%	4069	280	6.9%	4307	292	6.8%
G3	51	2	3.9%	1659	106	6.4%	1710	108	6.3%

	Single Women			Married Women without Small Children			Married Women with Small Children*			Women Total		
Job Grades	# of employees	Freq. of promotions	Promotion rate	# of employees	Freq. of promotions	Promotion rate	# of employees	Freq. of promotions	Promotion rate	# of employees	Freq. of promotions	Promotion rate
J1	215	130	60.5%	40	18	45.0%	6	2	33.3%	261	150	57.5%
J2, J3	1782	38	2.1%	1281	15	1.2%	606	2	0.3%	3669	55	1.5%
SA, J4	280	35	12.5%	96	14	14.6%	24	0	0.0%	400	49	12.3%
SB, JH	83	7	8.4%	57	10	17.5%	31	1	3.2%	171	18	10.5%
G6	54	6	11.1%	93	9	9.7%	43	1	2.3%	190	16	8.4%
G5	69	4	5.8%	80	4	5.0%	11	0	0.0%	160	8	5.0%
G4	18	0	0.0%	37	2	5.4%	0	0	0.0%	55	2	3.6%
G3	5	0	0.0%	15	0	0.0%	0	0	0.0%	20	0	0.0%

Figure 3 Separation rate by age, gender, and marital status

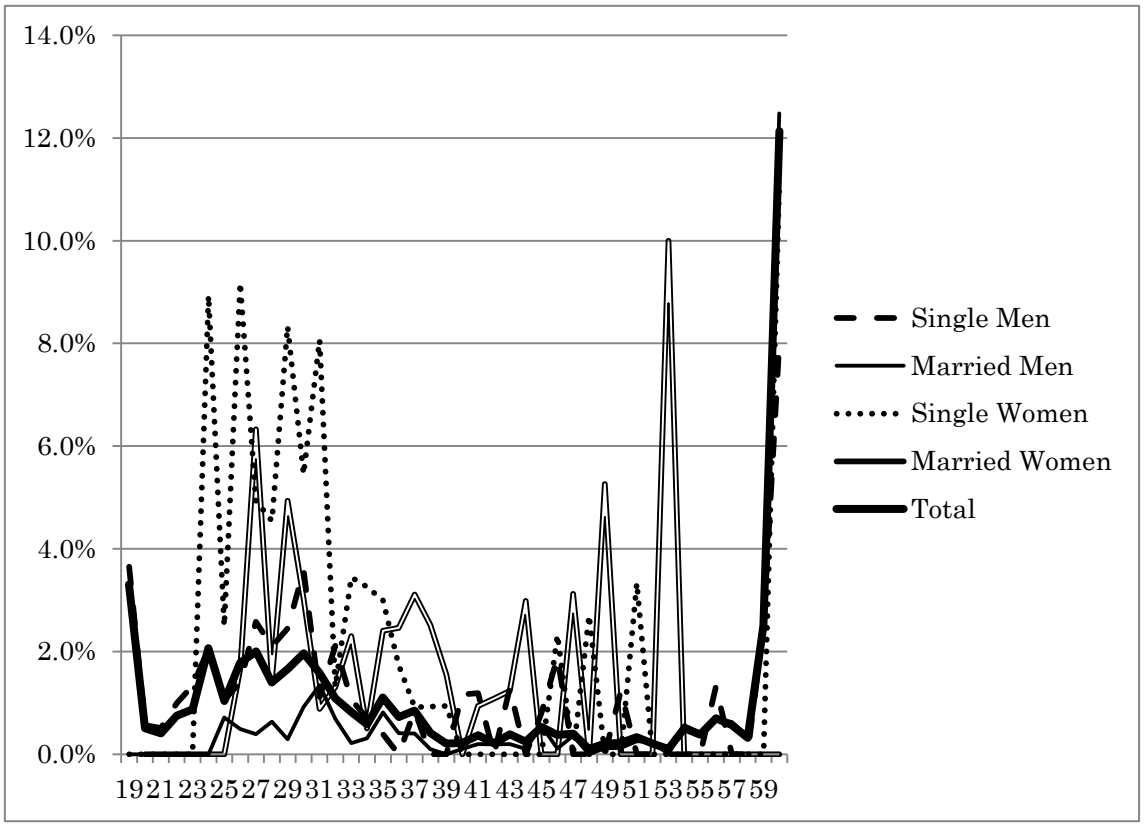


Table 6 OLS Estimation of Gender Pay Gap

Dependent variable	ln(total pay)		
	Base	w. education	Graduated in FY1987 and after
Marriage	**0.1214 *** **	**0.1078 *** **	**0.0991 *** **
	-0.0054	**-0.0043**	**(0.0044)**
Female	**-0.1708 *** **	**-0.1602 *** **	**-0.1240 *** **
	-0.0091	**-0.0084**	**(0.0091)**
Marriage × Female	**-0.1858 *** **	**-0.1504 *** **	**-0.1687 *** **
	-0.014	**-0.0114**	**(0.0118)**
Education (base: high school)			
Ph.D.		0.3955 ***	0.3099 ***
		-0.0108	(0.0110)
Master's degree		0.3324 ***	0.2435 ***
		-0.0047	(0.0056)
BS/BA		0.2127 ***	0.1338 ***
		-0.0058	(0.0057)
Technical College		0.1566 ***	0.1020 ***
		-0.0058	(0.0061)
2-year college		-0.0252 ***	-0.0708 ***
		-0.0086	(0.0092)
Middle school		-0.1213 ***	0.0188
		(0.0083)	(0.0826)
Vocational school		0.0202 **	-0.0227 **
		(0.0089)	(0.0097)
Vocational school (medical)		0.1490 ***	0.0879 ***
		(0.0136)	(0.0136)
Control for age and tenure	Yes	Yes	Yes
Control for fiscal year	Yes	Yes	Yes
R2 overall	0.6546	0.7743	0.8024
Number of observations	42073	42071	23728

Table 7 Explaining the Gender Pay Gap

Dependent Variable: ln(total earnings)

All Employees

	Independent variables	**R2**	**Gender Pay Gap/Marriage Premium**		
			Single	Married	Marriage P. for Men
Model 1	Age, tenure, and f. year dummies	0.6546	-0.1708	-0.3566	0.1214
Model 2	＋education	0.7743	-0.1602	-0.3107	0.1078
Model 3	＋# of dependents	0.7766	-0.1656	-0.2568	0.0637
Model 4	＋job grade, job skill rank	0.9182	-0.0886	-0.1668	0.0381
Model 5	＋hours worked	0.9593	-0.0028	-0.0349	0.0393
Model 6	+ evaluation	0.9596	-0.0052	-0.0356	0.0382

College Graduates only

	Independent variables	**R2**	**Gender Pay Gap/Marriage Premium**		
			Single	Married	Marriage P. for Men
Model 1	Age, tenure, and f. year dummies	0.7297	-0.1708	-0.2276	0.1123
Model 2	＋university ranking	0.7936	-0.1496	-0.2135	0.1000
Model 3	＋# of dependents	0.7962	-0.1445	-0.1643	0.0575
Model 4	＋job grade, job skill rank	0.9341	-0.0516	-0.0764	0.0453
Model 5	＋hours worked	0.9571	-0.0128	-0.0363	0.0504
Model 6	＋evaluation	0.9571	-0.0104	-0.0322	0.0491

Note：The figures are the coefficients in the estimated Mincerian wage function using the total compensation (monthly salary and bonus). Includes only regular employees who were in the payroll for twelve months.

Table 8 Use of Parenting/Family Care Leave by Type and Employee Characteristics

	Women	Men
# of employees in the sample	1022	8602
Those who have taken a leave	271	14
Average period	13.80	3.07
Type of leave		
Prenatal/postnatal/parental	187	
# of times leave was taken		
1	142	
2	38	N.A.
3	6	
4	1	
Family care	84	
By education level		
PhD	4	1
MS/MA	16	1
BS/BA	35	5
2-y college	78	0
High School	106	5
Others	32	2
Ave. Age in 2009 or at the exit	37.3	42.9

Table 9 Estimation of the Impact of Time Out on Wage Income

Dependent Variable: ln(total wage)	All Employees OLS				College Graduates OLS			
Marriage	0.0797	***	0.0584	***	0.0852	***	0.0621	***
	(0.0048)		(0.0050)		(0.0126)		-0.0128	
Female	-0.1772	***	-0.1536	***	-0.1331	***	-0.157	***
	(0.0088)		(0.0097)		(0.0211)		-0.0237	
Marriage × Female	-0.0802	***	-0.0291	**	-0.0534		-0.0063	
	(0.0138)		(0.0149)		(0.0484)		-0.053	
One maternity leave spell (*births*=1)	0.0106		0.0572	***	0.0963		0.116	
	(0.0216)		(0.0176)		(0.0734)		-0.0942	
Two or more maternity leave spells (*births*=2)	-0.0439		0.0740	***	-0.9245	***		
	(0.0709)		(0.0256)		(0.1578)			
leave_pd: *accumulated* length of leave in months	-0.0064	***	0.0003		-0.0079	***	0.0006	
	(0.0013)		(0.0011)		(0.0044)		-0.0058	
# of dependents	0.0348	***	0.0380	***	0.0335	***	0.0448	***
	(0.0034)		(0.0036)		(0.0091)		-0.0094	
Hours worked (ln(*hours*))			0.4742	***			0.444	***
			(0.0145)				-0.0329	
Reduced hours (ln(*jitan*+1))			-0.0367	***			-0.0746	***
			(0.0066)				-0.0291	
Night hours (ln(*yakan*+1))			0.0043	***			-0.021	***
			(0.0011)				-0.0029	
Working in the HQ	0.1446	***	0.1830	***	0.0840	***	0.0976	
	(0.0059)		(0.0065)		(0.0114)		-0.0114	
Control for age and tenure	Yes		Yes		Yes		Yes	
Control for education	Yes		Yes		Yes		Yes	
Control for fiscal year	Yes		Yes		Yes		Yes	
R2	0.7915		0.8212		0.7909		0.8204	
# of observations	42071		30351		8496		6059	

Table 10 Estimation of the Impact of Time Out on Wage Income by Gender

Dependent Variable:	Women			Men		
ln(total wage)	OLS	Fixed Effects	Fixed Effects	OLS	Fixed Effects	Fixed Effects
Marriage	0.0191 ***	-0.0124 ***	0.0177 ***	0.0521 ***	0.0489 ***	0.0440 ***
	(0.0106)	(0.0080)	(0.0062)	(0.0050)	(0.0038)	(0.0034)
One maternity leave spell (*births*=1)	**0.0166**	**0.0140 *** **	**0.0150 * **			
	(0.0138)	**(0.0235)**	**(0.0083)**			
Two or more maternity leave spells (*births*=2)	**0.0194**	**-0.1072 * **	**0.0550 ** **			
	(0.0196)	**(0.1056)**	**(0.0224)**			
***leave_pd: accumulated* length of leave**	**-0.0005**	**-0.0166 *** **	**-0.0023 ** **	**0.0023**	**-0.0377 *** **	**-0.0243 *** **
	(0.0008)	**(0.0035)**	**(0.0011)**	**(0.0153)**	**(0.0082)**	**(0.0059)**
# of dependents	0.0346 ***	0.0113	0.0173	0.0383 ***	0.0101 ***	0.0257 ***
	(0.0115)	(0.0107)	(0.0109)	(0.0037)	(0.0017)	(0.0026)
Hours worked (ln(*hours*))	0.6581 ***		0.4578 ***	0.4677 ***		0.2692 ***
	(0.0481)		(0.0224)	(0.0150)		(0.0104)
Reduced hours (ln(*jitan*+1))	-0.0102 *		-0.0174 ***	-0.0727 ***		-0.0083
	(0.0059)		(0.0024)	(0.0172)		(0.0090)
Late Night hours (ln(*yakan*+1))	0.0398 ***		0.0139 ***	0.0047 ***		0.0247 ***
	(0.0062)		(0.0053)	(0.0011)		(0.0008)
Working in the HQ	0.0010	0.0217 *	0.0163	0.2221 ***	0.0243 ***	0.0286 ***
	(0.0143)	(0.0123)	(0.0122)	(0.0066)	(0.0047)	(0.0051)
Control for age and tenure	Yes	Yes	Yes	Yes	Yes	Yes
Control for education	Yes	Yes	Yes	Yes	Yes	Yes
Control for fiscal year	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.7260	0.4517	0.7502	0.8214	0.4514	0.5825
# of observations	3000	4292	3000	27351	37779	27351

Table 11 Estimation of Time-Out Penalty on Wage Income by Gender (College Graduates only)

Dependent Variable:	College Graduate Women						College Graduate Men					
ln(total wage)	OLS		FE		FE		OLS		FE		FE	
Marriage	0.0759	***	0.0009		0.0327	**	0.0604	***	0.0629	***	0.0571	***
	(0.0406)		(0.0163)		(0.0141)		(0.0121)		(0.0085)		(0.0071)	
One maternity leave spell (*births*=1)	**0.062**		**-0.0455**	*****	**0.067**	*******						
	(0.0795)		**(0.0240)**		**(0.0215)**							
Two or more maternity leave spells (*births*=2)			**-0.9797**	*******								
			(0.0453)									
***leave_pd: accumulated* length of leave**	**-0.0031**		**-0.0178**	*******	**-0.0267**	*******	**0.0386**		**-0.0250**	*******	**-0.0120**	
	(0.0049)		**(0.0064)**		**(0.0058)**		**(0.0036)**		**(0.0075)**		**(0.0186)**	
# of dependents	0.0289		0.0499	**	0.1018	**	0.0381	***	0.0077	*		
	(0.0617)		(0.0240)		(0.0454)		(0.0086)		(0.0045)			
Hours worked (ln(*hours*))	0.6056	***			0.3695	***	0.4315	***			0.2069	***
	(0.1516)				(0.0622)		(0.0317)				(0.0233)	
Reduced hours (ln(*jitan*+1))	-0.0115				-0.0212	***	-0.0941	**			-0.0017	
	(0.0258)				(0.0081)		(0.0478)				(0.0110)	
Night hours (ln(*yakan*+1))	0.0333				0.0204	*	-0.0195	***			0.0217	***
	(0.0234)				(0.0117)		(0.0028)				(0.0022)	
Working in the HQ	-0.0591	*	-0.0051		-0.0069		0.1316	***	0.0265	***	0.0192	**
	(0.0325)		(0.0188)		(0.0122)		(0.0113)		(0.0079)		(0.0082)	
Control for age and tenure	Yes		Yes		Yes		Yes		Yes		Yes	
Control for education	Yes		Yes		Yes		Yes		Yes		Yes	
Control for fiscal year	Yes		Yes		Yes		Yes		Yes		Yes	
R2	0.6455		0.7392		0.7217		0.8528		0.4614		0.5671	
# of observations	571		790		571		5488		7706		5488	

Table 12 Impact of Parental Leave Period on Future Income

Sample: all female regular employees

	Parental Leave Period			
	2 months	12 months	24months	12 months × 2 children
Fixed effect (FE) model	-1.9%	-16.9%	-31.9%	-39.7%
FE model with hours worked as control	1.0%	-1.3%	-4.0%	-0.1%

Sample: college graduate female regular employees

	Parental Leave Period			
	2 months	12 months	24months	12 months × 2 children
Fixed effect (FE) model	-7.8%	-22.8%	-37.6%	N.A.
FE model with hours worked as control	1.4%	-22.4%	-43.7%	N.A.

Table 13: Ordered Logit Estimation of Promotion

Dependent variables	All employees			College graduates		
Job Grade	Base	w/ leave history	w/ evaluation	Base	w/ leave history	w/ evaluation
Marriage	0.3733 ***	0.3690 ***	0.2844 ***	0.3085 ***	0.3063 ***	0.2508 **
	(0.0510)	(0.0510)	(0.0516)	(0.1008)	(0.1009)	(0.1008)
Female	-1.0193 ***	-1.0201 ***	-0.9478 ***	-0.8858 ***	-0.8871 ***	-0.7528 ***
	(0.1212)	(0.1214)	(0.1305)	(0.2351)	(0.2366)	(0.2468)
Marriage × Female	-0.2478 *	-0.4146 ***	-0.3268 **	-0.4556	-0.6095	-0.5498
	(0.1368)	(0.1592)	(0.1625)	(0.3759)	(0.4453)	(0.4526)
One maternity leave spell (*births*=1)		0.8114 ***	0.8294 ***		1.3474 **	1.3352 **
		(0.1773)	(0.1824)		(0.5871)	(0.6236)
Two or more maternity leave spells (*births*=2)		1.2701 ***	1.2690 ***		0.7954	0.9649
		(0.3636)	(0.3820)		(0.9199)	(0.9863)
leave_pd: accumulated length of leave		-0.0160	-0.0130		-0.0349	-0.0320
		(0.0101)	(0.0105)		(0.0314)	(0.0337)
Evaluation : A1 or better			0.5491 ***			0.6466 ***
			(0.0313)			(0.0645)
Evaluation : A3 or worse			-0.4543 ***			-0.1305
			(0.0482)			(0.1050)
A1 or better × Female			-0.4139 ***			-0.2990
			(0.1102)			(0.2966)
A3 or worse × Female			0.0412			-0.3689
			(0.1406)			(0.3393)
Working in the HQ	1.6180 ***	1.6252 ***	1.6348 ***	0.8486 ***	0.8605 ***	0.8748 ***
	(0.0703)	(0.0702)	(0.0706)	(0.0996)	(0.0993)	(0.0998)
Control for age and tenure	Yes	Yes	Yes	Yes	Yes	Yes
Control for fiscal year	Yes	Yes	Yes	Yes	Yes	Yes
Control for education	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.2902	0.2906	0.2997	0.2908	0.2914	0.3009
Number of observations	35156	35156	34534	7134	7134	7018

Table 14: Probit Estimation of Conditional Probability of Promotion

Dependent variables	All employees			College graduates		
Promotion	Base	w/ hours worked	w/ evaluation	Base	w/ hours worked	w/ evaluation
Marriage	0.1341 ***	0.1400 ***	0.0640 *	0.0838	0.0999	0.0469
	(0.0309)	(0.0352)	(0.0359)	(0.0619)	(0.0708)	(0.0717)
Female	-0.1251 **	-8.6039 ***	-8.9478 ***	-0.0327	-8.9390 **	-9.0179 **
	(0.0596)	(2.0511)	(2.1467)	(0.1174)	(3.7740)	(3.9349)
Marriage × Female	-0.0791	0.0947	0.1312	-0.2276	-0.0872	-0.1289
	(0.0862)	(0.0982)	(0.0989)	(0.1730)	(0.2008)	(0.2018)
One maternity leave spell (*births*=1)	-0.0627	-0.0778	-0.0810	-0.0422	-0.1361	-0.2336
	(0.1449)	(0.1875)	(0.1903)	(0.4088)	(0.4568)	(0.4354)
leave_pd: accumulated length of leave	-0.3625	-0.0250 **	-0.0229	-0.0318	0.0103	0.0260
	(0.2209)	(0.0126)	(0.0131)	(0.0201)	(0.0218)	(0.0230)
Lagged hours worked (log)		1.0687 ***	0.7461 ***		1.1917 ***	0.9622 ***
		(0.1403)	(0.1436)		(0.2692)	(0.2795)
Female × Lagged hours worked		1.6381 ***	1.6999 ***		1.7202 **	1.7371 **
		(0.3974)	(0.4161)		(0.7291)	(0.7604)
Lagged reduced hours (log)		0.0791	0.0859			
		(0.1121)	(0.1110)			
Lagged late night hours (log)		-0.1092 ***	-0.0980 ***		-0.1375 ***	-0.1318 ***
		(0.0119)	(0.0122)		(0.0309)	(0.0316)
Evaluation : A1 or better			0.4468 ***			0.3578 ***
			(0.0324)			(0.0705)
Evaluation : A3 or worse			-0.3752 ***			-0.2614 **
			(0.0559)			(0.1075)
Working in the HQ	0.3255 ***	0.3770 ***	0.3957 ***	0.2361 ***	0.3239 ***	0.3270 ***
	(0.0427)	(0.0483)	(0.0492)	(0.0614)	(0.0732)	(0.0747)
Pseudo R^2	0.1506	0.1689	0.1954	0.1451	0.1625	0.1787
Number of observations	31432	23692	23412	5811	4433	4410

Note: Age, tenure, education, job grade, and fiscal year are all controlled for but their coefficients are omitted from the table.

Table 15: Fixed Effect Logit of Conditional Probability of Promotion

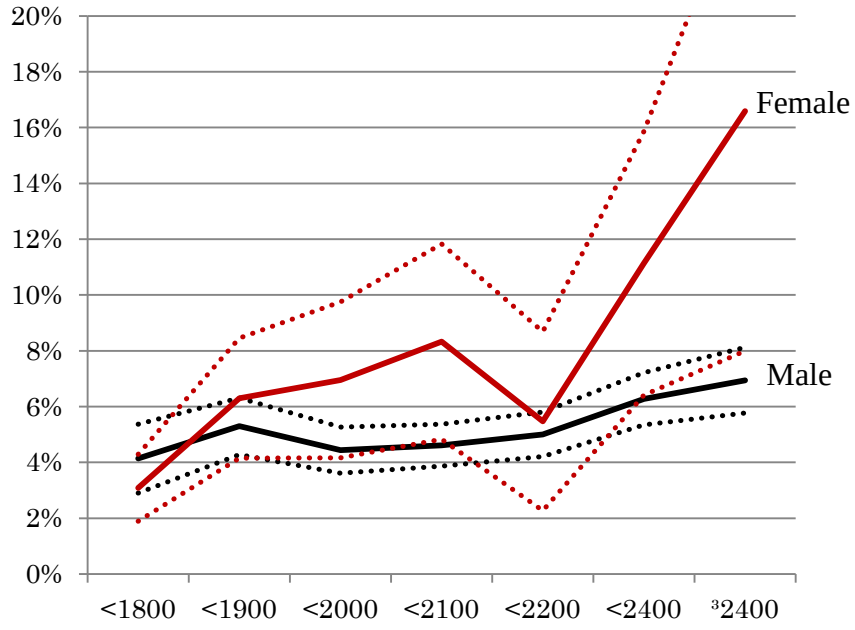
Dependent variables	All employees			College graduates		
Promotion	Base	w/ hours worked	w/ evaluation	Base	w/ hours worked	w/ evaluation
Marriage	0.3178 ***	0.3241 ***	0.1557 *	0.3401 **	0.3546 *	0.2898
	(0.0733)	(0.0824)	(0.0845)	(0.1727)	(0.1960)	(0.1999)
Female	-0.4154 ***	-17.6632 ***	-18.5046 ***	-0.5758 *	-43.0138 ***	-42.3820 ***
	(0.1533)	(5.6232)	(5.7961)	(0.3359)	(12.9890)	(13.0573)
Marriage × Female	-0.0967	0.2362	0.3122	-0.7045	-0.3371	-0.4818
	(0.2011)	(0.2296)	(0.2345)	(0.4968)	(0.5332)	(0.5392)
One maternity leave spell	0.1454	-0.0835	-0.0116	-3.4435 **	-3.6859 **	-3.8357 **
(*births*=1)	(0.4742)	(0.5278)	(0.5285)	(1.6373)	(1.6324)	(1.5950)
Two or more maternity leave	-16.93	-16.70	-16.57	-19.64	16.94	15.92
spell (*births*=2)	(8452.59)	(9229.98)	(9597.36)	(4177.32)	(1361.09)	(903.49)
leave_pd: accumulated length of	-0.1264 ***	-0.0696 *	-0.0741 *	0.1128	0.3411 ***	0.3553 ***
leave	(0.0348)	(0.0391)	(0.0401)	(0.0829)	(0.0972)	(0.0971)
Lagged hours worked (log)		2.8671 ***	1.9621 ***		2.1804 **	1.6848 *
		(0.3718)	(0.3820)		(0.8836)	(0.9008)
Female × Lagged hours worked		3.3594 ***	3.5137 ***		8.2417 ***	8.1086 ***
		(1.0915)	(1.1246)		(2.5104)	(2.5243)
Lagged reduced hours (log)		0.0302	0.1328		-17.46	-16.99
		(0.2829)	(0.2832)		(1635.10)	(1254.92)
Lagged late night hours (log)		-0.2313 ***	-0.2201 ***		-0.1846 **	-0.1886 **
		(0.0312)	(0.0318)		(0.0878)	(0.0882)
Evaluation : A1 or better			0.8176 ***			0.6548 ***
			(0.0708)			(0.1620)
Evaluation : A3 or worse			-0.8533 ***			-0.6036 **
			(0.1295)			(0.2645)
Pseudo R^2	0.1814	0.2051	0.2314	0.2395	0.2590	0.2725
Number of observations	30047	22590	22320	4280	3180	3141

Note: Age, tenure, education, job grade, and fiscal year are all controlled for but their coefficients are omitted from the table.

Figure 4 Predicted Odds of Promotion

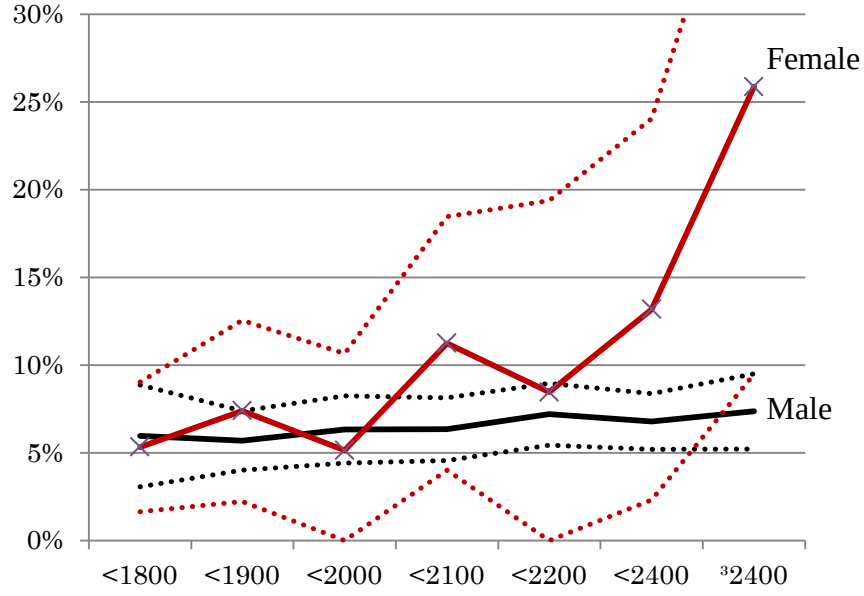
– Dotted lines indicate 95% confidence interval.
– Figures in the tables show distribution by hours worked

(4-1) All employees



Female	43.3%	22.6%	12.7%	9.1%	5.3%	5.3%	1.8%
Male	6.8%	15.0%	15.2%	21.2%	16.9%	15.1%	9.9%

(4-2) College graduate employees



Female	30.2%	20.9%	15.4%	14.5%	6.2%	8.8%	4.0%
Male	7.2%	20.9%	12.6%	18.1%	15.2%	14.8%	11.3%

Table 16 Ordered Logit Estimation of Evaluation

Dependent variables	All employees		College graduates	
Evaluation	Base	w/ leave history & hours worked	Base	w/ leave history & hours worked
Marriage	-0.6032***	-0.6190***	-0.5835***	-0.5645***
	(0.0440)	(0.0476)	(0.0953)	(0.1041)
Female	-0.2773***	-0.2568***	0.0195	-0.0725
	(0.0836)	(0.0910)	(0.1446)	(0.1552)
Marriage × Female	0.7722***	0.2527**	0.3275	-0.0795
	(0.1062)	(0.1270)	(0.2172)	(0.2431)
Ph.D.	0.5208***	0.5529***		
	(0.1220)	(0.1397)		
MS/MA	0.4686***	0.5028***		
	(0.0651)	(0.0704)		
BS/BA	0.2749***	0.3011***		
	(0.0509)	(0.0553)		
Technical College	0.1386*	0.2477***		
	(0.0724)	(0.0776)		
2-year college	-0.1578	-0.1364		
	(0.1043)	(0.1117)		
One maternity leave spell (*births*=1)		0.2994*		0.2894
		(0.1694)		(0.4471)
Two or more maternity leave spells (*births*=2)		-0.0932		1.1006
		(0.3279)		(1.1874)
leave_pd: *accumulated* length of leave		0.0048		-0.0094
		(0.0103)		(0.0291)
Hours worked (log)		-2.2148***		-1.7047***
		(0.1742)		(0.3363)
Reduced hours (log)		0.1508**		0.4257***
		(0.0615)		(0.1560)
Late night hours (log)		0.0921***		
		(0.0147)		
Working in the HQ	0.0553	-0.0021	0.0751	-0.0162
	(0.0462)	(0.0508)	(0.0773)	(0.0847)
Control for age and tenure	Yes	Yes	Yes	Yes
Control for school ranking	No	No	Yes	Yes
Control for job grade	Yes	Yes	Yes	Yes
Control for fiscal year	Yes	Yes	Yes	Yes
Pseudo R^2	0.0478	0.0533	0.0486	0.0460
Number of observations	43023	34453	8871	7220