Unpacking the Child Penalty Using Personnel Data: How Promotion Practices Widen the Gender Pay Gap

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Abstract

We estimate the child penalty using detailed personnel records that enable decomposition into distinct pay components. Our analysis reveals that the penalty is initially driven by reductions in time-based pay following childbirth. However, job-rank-based pay becomes increasingly significant over time, emerging as the dominant factor by the 15-year mark. These effects are interconnected: reduced working hours lead to lower performance evaluations, which subsequently limit promotion opportunities. Our theoretical model demonstrates that current promotion practices, which reward extended hours at entry-level positions, can generate production inefficiency. This finding suggests that addressing promotion practices could simultaneously reduce gender inequality and improve talent allocation, making a compelling business case for organizational reform.

Keywords: Child penalty, promotion, management practice, personnel economics, internal labor markets, gender pay gap, career progression

JEL Codes: J13, J16, J24, J31, M51

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1 Introduction

Despite women's increasing educational qualifications and growing presence in high-paying occupations, gender pay gaps persist across advanced economies (Goldin, 2014). These gaps suggest potential misallocation of talent,[1] with implications for both equity and efficiency. Recent studies identify motherhood as a primary driver of modern gender inequalities, estimating that earnings differences between men and women are now largely attributable to the differential impacts of parenthood on career trajectories.[2] While existing research has illuminated various worker-side mechanisms — including labor market sorting[3] and gender norms[4] — the role of organizational practices, particularly firms' internal promotion systems, remains underexplored. This is particularly consequential given that within-firm wage growth, rather than between-firm sorting, accounts for the majority of lifetime earnings inequality between men and women.

We examine how HR (human resource) management policies and practices affect the child penalty using detailed internal personnel records from a Japanese manufacturing firm. A unique aspect of this dataset is its comprehensive breakdown of payroll data, which is provided on a monthly basis and categorized by various pay components. This allows us to decompose earnings into different pay categories and analyze how each contributes to earnings trajectory over workers' careers, particularly before and after the birth of the first child. The personnel records also track monthly working hours, job assignments, promotions, leave-taking, annual evaluations, and employee surveys. This rich dataset enables us to investigate the mechanisms driving these earnings patterns.

Our firm provides an ideal setting for studying how HR management practices influence within-firm earnings dynamics and the child penalty for several reasons. First, the firm's low annual quit rate of 4% reflects its position as a large employer offering competitive compensation and comprehensive leave benefits, which minimizes sample attrition concerns and enables long-term observation of career trajectories. Second, the firm provides a representative case in terms of gender disparities: its within-firm gender pay gap of 30% and women's 8% representation in management closely align with both the national average and manufacturing sector average. Third, the firm has implemented family-friendly policies that substantially exceed Japan's already generous national mandates. The persistence of gender gaps despite these supportive policies suggests that organizational factors beyond formal policies, particularly HR practices and workplace dynamics, may drive the disparities. Through analyzing this firm's detailed personnel records, we can illuminate

[1] See Hsieh et al. (2019); Sevilla (2020); Bandiera et al. (2022).

[2] See Bertrand et al. (2010); Kleven et al. (2021); Bertrand (2020); Cortés and Pan (2023)

[3] See Goldin (2014); Goldin and Katz (2016); Adda et al. (2017); Kleven et al. (2019b); Casarico and Lattanzio (2021).

[4] See Moberg (2016); Nix and Andresen (2019); Kleven (2022).

how HR practices contribute to the globally observed child penalty.

To quantify the impact of childbirth on monthly earnings trajectories, we employ a matched-control event study design to identify and estimate the child penalty several years after childbirth. Each worker who has a child is matched with a pure control — another worker of the same sex, marital status, birth cohort, and education level, but who never had a child during the observation period. Using this matched sample, we perform an event study regression on several outcomes, including both total monthly earnings and its components. Specifically, we categorize the firm's 27 distinct pay items into four main components: (i) age-based pay, which increases with age; (ii) time-based pay, which encompasses overtime, night shift, and weekend shift compensation; (iii) job-rank-based pay, which rises with higher positions and includes managerial compensation; and (iv) other allowances unrelated to the above categories. Additionally, we estimate the impacts on expressed promotion aspirations and work-family conflicts. We demonstrate that the parallel trend assumption holds for each outcome in the period leading up to childbirth.

The event study analysis indicates the following key results: the estimated ten-year child penalty is 55%, with its sources evolving over time. Immediately after childbirth, time-based pay accounts for nearly 90% of the penalty. As time progresses, the contribution of time-based pay decreases, while job-rank-based pay becomes increasingly significant. By the ten-year mark, time-based pay's contribution falls to 60%, while job-rank-based pay accounts for 17%. Beyond ten years, the influence of rank-based pay rises sharply, becoming the dominant factor by the 15-year mark. Even though childbirth do not significantly affect both mothers' and fathers' career aspirations in the employee survey, nearly 80% of mothers reduce their working hours until their children turn 12, while most fathers do not. This gendered pattern reflects the uneven distribution of childcare responsibilities at home.[5]

The shift in the sources of the child penalty is not simply sequential but deeply intertwined. Our data further indicate that reduced work hours lower annual evaluation scores at the lowest job rank. These lower annual evaluations limit promotion opportunities. The importance of work hours, however, is significant only at the entry level. As workers climb the promotion ladder, the link between hours worked and evaluation scores is faded. In other words, long working hours are crucial for initially securing a path to promotion, but become less important as employees progress in their careers. This is particularly relevant because most new parents are at the lowest job rank. As a result, childbirth reduces mothers' earnings in two key ways: their monthly pay decreases immediately due to parental leave and reduced hours, and their future earnings are hampered by

[5] In the employee survey, women express a need for work accommodations twice as often as men post-childbirth. This aligns with national trends: Japanese women spend five times more time on household duties than men — the largest gender gap among OECD countries.

diminished promotion prospects due to these reduced hours. The latter represents the true essence of the term *child penalty*, highlighting systemic repercussions.

To interpret these empirical findings and investigate welfare implications for HR management practices, we investigate a theoretical model of internal promotion building upon Gibbons and Waldman (1999). The model incorporates three key features. First, workers differ in their time-invariant abilities and in the marginal cost of work due to childcare responsibilities. Second, reflecting the promotion system of our sample firm, workers face the same promotion thresholds and are promoted step-by-step without skipping any job rank. Third, consistent with our empirical finding, long working hours improve promotion prospects only at the lowest job rank. We show that this promotion system incentivizes workers with lower abilities but fewer time constraints to work excessively long hours to secure a promotion path. Consequently, even in a simple model with full information and no discrimination or bias, these promotion practices can generate both production and Pareto inefficiency.[6] This inefficiency stems from talent misallocation that disadvantages high-ability workers who face high time costs.[7]

The model offers a framework for interpreting our empirical patterns. In our institutional context, mothers typically face substantial time constraints due to childcare responsibilities, while fathers experience minimal changes to their time availability. The theoretical analysis suggests that within the current promotion system, high-ability mothers systematically face greater barriers to advancement beyond entry-level positions compared to equally or less capable fathers who retain temporal flexibility. These promotion dynamics amplify the child penalty over time. Moreover, this mechanism can generate production inefficiency, as capable women remain in lower-ranked positions despite their underlying productivity. Our analysis indicates that redesigning promotion and evaluation practices could both mitigate the long-term child penalty and improve organizational productivity, providing both equity and efficiency rationales for management reforms.

Contribution to Literature To our knowledge, this study is one of the first to use pay records to decompose the child penalty and examine how HR management practices influence its magnitude and evolution. Both analyses are made possible by detailed firm-level personnel data.[8] In doing so,

[6]The latter result holds in our model because of the assumption that workers are paid at their own productivity.

[7]Bronson and Thoursie (2021) also analyze a model with multiple promotion opportunities, focusing on parental leave and subsequent gender differences in wage growth. Our model differs by highlighting how existing promotion systems can distort production efficiency, especially on employees with childcare responsibilities.

[8]A recent study by Healy and Heissel (2024) uses personnel data to examine child penalty. Analyzing internal records in the US Marine Corps, they estimate the negative impacts of childbirth on Marine women's physical fitness performance, on-the-job training assignments, and promotions up to two years post-birth. Marine men also experience a decline in physical fitness, though for a shorter period. These findings emphasize that parenthood, particularly

we contribute to three strands of literature.

First, we deepen the understanding of long-term drivers of the child penalty by tracking how the birth of a first child affects mothers' long-term earnings within a firm. While the post-childbirth earnings drop for mothers is well-documented (Waldfogel, 1997; Lundberg and Rose, 2000; Ejrnaes and Kunze, 2013; Angelov et al., 2016; Lundborg et al., 2017; Kleven et al., 2019b), its size, interpretation, and underlying mechanisms are still debated (Lundborg et al., 2024; Adams-Prassl et al., 2024c). In particular, within-firm dynamics contributing to this penalty remains to be explored. The existing literature has focused primarily on worker-related characteristics: biological traits contribute minimally to the child penalty (Kleven et al., 2021); while productivity shifts (Antecol et al., 2018; Kim and Moser, 2021; Healy and Heissel, 2024) and gender norms (Moberg, 2016; Nix and Andresen, 2019; Kleven, 2022) play substantial roles. Labor market sorting emerges as another key mechanism, with women often selecting into positions offering shorter hours, greater substitutability or greater flexibility, but at a cost of lower compensation and fewer advancement opportunities (Manning and Petrongolo, 2008; Fernández-Kranz et al., 2013; Goldin, 2014; Goldin and Katz, 2016; Adda et al., 2017; Kleven et al., 2019b; Casarico and Lattanzio, 2021; Azmat et al., 2022). While these findings underscore the importance of supporting work-family balance and encouraging gender-neutral caregiving, public policies targeting these objectives have shown limited effectiveness (Kleven et al., 2020; Nix and Andresen, 2024). Our analysis suggests that organizational practices, particularly HR management policies, may offer a complementary pathway for mitigating the child penalty beyond the scope of public interventions.

Second, our findings contribute to the literature on the widening gender pay gap over the life cycle. Recent research using administrative data from North America and Europe demonstrates that within-firm wage growth, rather than between-firm sorting, plays the dominant role in explaining the expansion of gender pay disparities over workers' careers (Card et al., 2016; Frederiksen et al., 2016; Barth et al., 2021; Bronson and Thoursie, 2021; Casarico and Lattanzio, 2022). These findings highlight the importance of understanding gender differences in within-firm hierarchical mobility — specifically, promotion patterns. Our comprehensive personnel records, which include detailed information on earnings, work hours, performance evaluations, and employee attitudes, allow us to identify the specific mechanisms through which gender gaps in promotion emerge and

for women, is physically demanding, which can affect workplace performance and hinder promotion prospects. Their study highlights the important policy issue of providing reasonable accommodations for workers' birth-related medical conditions, particularly for new parents in physically demanding jobs. This is especially crucial in a context where parental leave is short (6-18 weeks at the US Marine Corps). In contrast, our study examines a context where maternal and parental leave is generous (up to 52 weeks), so the physical fitness channel is less likely to be at play. Complementing their study, our research illuminates mothers' and fathers' working hours and their *long-term* career consequences, using comprehensive personnel records that contain detailed pay records, as well as performance evaluation and promotion records.

persist. In particular, we demonstrate how organizational policies and practices create systematic differences in career progression between men and women after childbirth.

Third, we contribute to the literature on the mechanisms underlying gender disparities in promotions (Lazear and Rosen, 1990; Blau and Devaro, 2007). Recent studies examining career trajectories across various contexts — including lawyers (Azmat and Ferrer, 2017; Ganguli et al., 2021; Azmat et al., 2024), central bankers (Hospido et al., 2022), and a global corporation (Haegele, 2024a) — find that differences in promotion aspirations substantially explain observed promotion gaps. While our data show similar post-childbirth divergence in career aspirations between mothers and fathers, these differences are not statistically significant. Instead, our analysis emphasizes the role of organizational architecture, particularly personnel policies and promotion criteria. Prior work has identified several potential mechanisms driving the gender promotion gap, including managerial bias in subjective performance evaluations (Haegele, 2024b; Benson et al., 2024) and discrimination against mothers (Bronson and Thoursie, 2021). Our findings suggest that promotion disparities can emerge even in the absence of explicit discrimination or bias. Specifically, we demonstrate that promotion systems that reward extended work hours create barriers to advancement that disproportionately affect women with childcare responsibilities.

Organization of the Paper The remainder of this paper is organized as follows. Section 2 provides a brief background on the firm we investigate, and describe our data. Section 3 documents the evolution of child penalty. Section 4 further investigates promotion dynamics in the firm. Section 5 presents an illustrative model of internal promotion that aligns with our empirical findings, and discusses the welfare implication of the personnel policies and practices in the firm. Section 6 concludes.

2 Background and Data

2.1 The firm

This study examines a large, anonymous Japanese manufacturing firm that produces consumer nondurable goods. With approximately 4,000 regular workers as of 2013, the firm operates in Japan's manufacturing sector, an industry accounting for roughly 20% of GDP and 16% of total employment. This setting offers three distinct advantages for studying how childbirth affects gender disparities in career trajectories within a firm.

The first key advantage is the firm's low annual quit rate of 4% among both men and women (see detailed statistics in Section 2.3.2). This stability stands in marked contrast to settings with high turnover, where workers frequently exit the sample. With most workers remaining at the firm long-term, we can track career trajectories and observe how gender gaps evolve over extended periods within a firm, particularly around key life events like childbirth. While this low turnover rate is characteristic of large Japanese firms offering competitive compensation packages,[9] it provides crucial analytical advantages for our research design.

Second, the firm provides a representative case in terms of gender disparity at work in Japan, where one of the largest gender gaps in the OECD exists. The firm's gender pay gap of approximately 30% closely aligns with both the national average (25%) and manufacturing sector average (26%). Similarly, women hold 8% of managerial positions, which is below the national average of 19% but close to the manufacturing sector average of 7%. These patterns suggest that our findings may offer insights into broader gender gaps, especially in male-dominated sectors where gender disparities are most pronounced.

Third, the firm allows us to examine an important segment of the maternal labor force. It stands out among similarly-sized firms by offering comprehensive family-friendly policies that exceed Japan's national mandates.[10] As documented in Appendix B.1, women with access to such policies demonstrate significantly higher employment attachment and lower turnover rates compared to those without access. This pattern means that our sample represents an important group of working mothers, who remain employed at firms with strong family support and have the potential to excel in their careers as men do.

Together, these three key advantages — low turnover enabling long-term tracking, representative gender gaps, and comprehensive family policies — make this firm an ideal setting for investigating how childbirth affects mens and women's career trajectories. By examining career dynamics in an environment where institutional barriers to combining work and family are minimized, we can gain insights into why gender pay gaps persist even when workplace policies strongly support working parents, and can shed light on why family-friendly policies alone might not be sufficient to close persistent gender gap at work.

[9] According to Toyo Keizai Inc., a major market database provider in Japan, the annual quit rate in 2022 was 4.12% among the 546 listed and major unlisted firms with over 1,000 employees surveyed for their CSR database.

[10] The firm extends reduced work hours for parents until their children reach age 12, well beyond the legally required age of three. It also provides in-house childcare facilities and flexible work-from-home arrangements tailored for parents. These policies are particularly noteworthy given that only about 40% of Japanese firms offer formal reduced work-hour options for parents.

2.2 Sample and Variable Definitions

We restrict our sample to permanently contracted employees under 60, the current default retirement age at the firm. Our sample does not include temporary workers. All personnel records are observed for all employees in our sample and linked using anonymized employee identification numbers. Table 5 in Appendix A summarizes our data sources, detailing the frequency of observations, the periods covered, and the sample coverage.

Job Title, Division Assignment, and Promotion The personnel record provides us with each worker's job assignment every month between September 2013 and January 2024. During this period, we also have complementary records of the exact dates of job assignment change. Within the firm, jobs are differentiated both horizontally and vertically. Horizontally, roles are divided into three divisions: manufacturing, sales, and back-office functions such as finance and HR. The production division is the largest, with 58% of employees. 19% of employees work in the sales division, while the remaining employees work in back office. Most horizontal job sorting occurs at the entry stage and is rare later in one's career, although not precluded by the employment contract.

Within each division, jobs are vertically differentiated by rank, with compensation increasing as employees advance. We define promotion as an upward progression from one rank to another. Our data record the precise date of each rank change, eliminating potential subjectivity in identifying promotions from wage growth. The first three ranks — *staff member*, *team leader*, and *senior team leader* — are classified as non-managerial positions. Positions above *senior team leader* are designated as managerial according to firm policy. The promotion structure is strictly sequential: employees must advance through consecutive ranks without skipping levels. While the employment contract permits downward mobility, demotion occurs rarely in practice.

Hours Worked Monthly payroll data between September 2013 and January 2024 provide a comprehensive view of both the amount and timing of work hours for non-managerial employees. Specifically, we have monthly data on each worker's contracted hours and actual hours worked. Actual hours are further categorized into regular hours, overtime, irregular hours (including night, weekend, and holiday shifts), and reduced hours for childcare. Employees with children under 12 can opt for reduced hours with a proportional reduction in pay. Note that the data do not record the actual hours worked by managers, as they have discretion over their working hours and are exempt from overtime compensation. Therefore, our analysis of hours worked and hourly pay is limited to non-managerial employees.

Monthly Pay by Item The firm employs a structured compensation system that determines monthly earnings through a combination of base pay adjustments and various supplemental components. The base pay, determined by age and job rank, represents the wage rate for standard full-time work. This base amount is then adjusted according to actual hours worked, with overtime hours receiving a premium and reduced hours resulting in proportional reductions. During parental leave, salaries fall to zero as leave benefits are administered through employment insurance rather than the firm.

Given this institutional structure, we decompose monthly earnings into four components using detailed payroll records. The firm's monthly payroll data itemizes 27 distinct pay categories, which we aggregate into: (1) time-based pay, (2) job-rank-based pay, (3) age-based pay, and (4) allowances. This decomposition enables us to analyze how different institutional channels contribute to earnings growth throughout an employee's career at the firm.

1. The time-based pay component reflects adjustments to base pay based on deviations from standard full-time hours. This includes positive adjustments for overtime, night, and holiday shifts, as well as negative adjustments when employees work reduced hours. During parental leave, this component becomes negative enough to reduce total earnings to zero.
2. The job-rank-based pay component is tied to an employee's job rank. Each rank has a narrow pay band, within which individual pay is determined by performance evaluations from immediate supervisors and those two ranks above. Additionally, managers receive a fixed amount of managerial compensation. An increase in job-rank-based pay is directly linked to a promotion within the firm's organizational hierarchy.
3. The age-based pay component is determined by both educational qualifications and age. Entry-level base pay increases with employees' educational qualifications. As employees age, this component automatically increases by a modest amount. It is not influenced by hours worked or job ranks.
4. Allowances include various supplemental payments: family allowance for household heads, professional license/certification premiums (e.g., for boiler operators), and training supplements. Most allowances apply to a small subset of workers and involve modest or infrequent payments. The family allowance is the notable exception: it provides substantial additional compensation to household heads, defined as employees with dependent children and a spouse earning below $10,400 annually. While this allowance is formally gender-neutral, in practice it creates systematic gender differences in pay since male employees typically qualify as household heads while female employees rarely do.[11]

[11] Family allowances, originating from social welfare policies, first introduced in Europe during the early 20th cen-

Each pay component is calculated according to a pre-determined formula. Individual pay negotiation cannot directly influence specific salary items. To increase her pay, an employee must negotiate for a higher evaluation and promotion to a higher job rank. Alternatively, the labor union can negotiate changes to the pay formula on behalf of all non-managerial employees. This implies that the gender pay gap does not stem from differences in willingness to negotiate or negotiation skills between men and women conditional on observed employee characteristics, such as age and job ranks.

The proposed decomposition offers an analytical advantage for studying how parenthood affects earnings trajectories. Specifically, this categorization maps directly onto the firm's personnel policies and promotion practices, enabling us to identify specific organizational mechanisms that generate earnings disparities between men and women following childbirth. In addition, by separating rank-based from age-based components, we can distinguish career advancement effects from mechanical wage growth. While alternative approaches might express earnings simply as the product of hours worked and wage rates, our decomposition better serves our goal of understanding how different institutional channels contribute to the child penalty over time.[12]

Personnel Evaluation Score The firm employs a 5-point performance rating scale for its annual evaluations, ranging from 1 (lowest) to 5 (highest). These ratings are retrospective, based on a set of demonstrable criteria evaluated by immediate supervisors and subsequently approved by higher-level supervisors. The evaluation criteria assess both individual performance and teamwork skills over the past year.

Employee Demographics Finally, we collect data on employees' sex, age, tenure, highest degree attained, marital status, number of children, and the birth year and month of both the employees and their children.

tury. During World War II, the Japanese government, as part of its warfare strategy, regulated company wage scales and mandated family allowances to alleviate poverty. This practice, although no longer required, has continued to influence pay structures in firms long after World War II ended. According to a 2020 survey from the Ministry of Health, Labour, and Welfare, about 70% of firms with more than 30 employees offer family allowances. Recently, family allowances have faced increasing criticism. Critics argue that it perpetuates the outdated family model of "a working husband and a stay-at-home wife," despite the growing diversity in family structures in Japan.

[12]An alternative approach would be to express earnings as the product of hours worked and wage rates and analyze changes in log earnings. However, such an approach cannot handle zero-earnings periods during parental leave without arbitrary adjustments. In addition, it is hard to further decompose wage rates into detailed components such as a job-rank-based component. Our decomposition avoids this issue while maintaining the ability to separate hours-based adjustments from changes in wage rates.

2.3 Summary Statistics

2.3.1 Employee Demographics

Table 1 presents summary statistics for our entire sample in Column 1, as well as male employees in Column 2 and female employees in Column 3 as of September 2013. Female employees account for 20% of the sample. On average, they are younger (27.89 years old) than their male counterparts (39.83 years old). Consequently, women have shorter tenure. Men and women have similar educational backgrounds, with 34.2% of men and 28.5% of women having graduated from some college or above.

There is a noticeable gender difference in the distribution of job ranks. 96.4% of female employees are at the entry-level job rank, whereas the figure for men is 59%. This disparity is partly due to differences in tenure between genders. However, it also suggests the presence of a broken rung phenomenon, where women in entry-level positions are promoted to managerial positions at much lower rates than their male counterparts (McKinsey and LeanIn, 2019). We will discuss a possible broken rung in connection to the child penalty on promotion in Section 4.

2.3.2 Employee Turnover and Post-Childbirth Employment Status

The firm's low employee quit rate offers an ideal setting for studying within-firm earnings dynamics, as it minimizes concerns about sample attrition. The overall annual quit rate across all ages is approximately 4%, declining as employees age and stabilizing in their 30s (see Appendix A Figure 12). This figure presents the average annual quit rate by age and gender, calculated by dividing the total number of voluntary quits in a given year by the number of employees of the corresponding age and gender at the start of the year. Women's quit rates are slightly higher than men's until age 25, after which there is no statistically significant difference between genders.

Notably, the low quit rate extends even to female employees following their first childbirth, a subgroup conventionally considered at high risk of exiting the labor force. Figure 1 illustrates the changing proportions of mothers who continue working full-time, reduce their hours, take parental leave, or leave their jobs.[13] The average annual quit rate over the 10 years post-birth is 1.1%, which

[13]We extract data on employee turnover, parental leave uptake, and reduced working hours for women with children from internal personnel records. Specifically, our dataset comprises a balanced panel of women who had their first child before September 2013. For those who subsequently left the company, we lack records of their children's birth dates. Therefore, we infer the timing of childbirth based on the start date of post-birth maternity leave. We validate this inference method using data from current employees with known family characteristics.

Table 1: Summary Statistics (As of September 2013)

	Overall (n = 3891)	**Men** (n = 3151)	**Women** (n = 740)
Age (Year)			
Mean	37.56	39.83	27.89
Education			
4-Yr College (%)	31.4%	33.2%	23.8%
Some college (%)	1.7%	1.0%	4.7%
High school (%)	66.8%	65.7%	71.5%
Missing (%)	0.1%	0.1%	0.0%
Sex			
Men (%)	81.0%	100.0%	0.0%
Women (%)	19.0%	0.0%	100.0%
Tenure (Year)			
Mean	16.20	18.21	7.68
Monthly Wage			
Total (USD)			
Mean	3,896	4,170	2,730
Time (USD)			
Mean	690	748	440
Rank (USD)			
Mean	1,892	2,037	1,278
Age (USD)			
Mean	1,028	1,055	915
Family Allowance and Others (USD)			
Mean	286	330	97
Job rank			
Staff Member (%)	66.1%	59.0%	96.4%
Team Leader (%)	12.2%	14.9%	0.8%
Senior Team Leader (%)	11.9%	14.1%	2.4%
Manager (%)	9.7%	11.9%	0.4%
Missing (%)	0.0%	0.0%	0.0%
% with child	34.8%	40.8%	9.3%
# of children			
Mean	0.68	0.81	0.14
Age of the youngest child (Year)			
Mean	10.90	11.15	6.26

Notes: All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY, which was the average exchange rate in September 2013, the starting point of our payroll data.

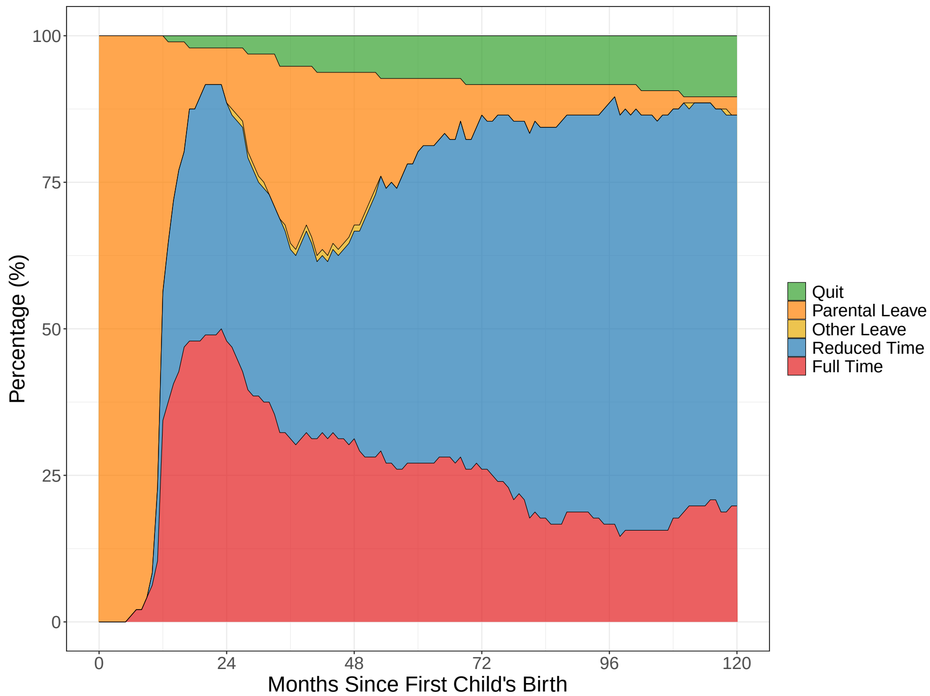


Figure 1: Women's Post Birth Employment Status

Notes: This figure presents a monthly breakdown of female employee outcomes up to 120 months after the birth of their first child. It shows the proportion of employees who quit the firm, took parental leave, opted for reduced working hours, or continued to work full-time. Unlike other event study analyses, this figure is limited to 120 months due to data availability on the birth year and month of the first child for workers who left the firm.

is significantly lower than the firm's overall voluntary quit rate of 4.0%. This suggests that childbirth does not increase quit rates.

The high firm attachment of mothers is likely attributed to the company's generous family-friendly policies. Nearly 80% of mothers choose to reduce their work hours at some point, a benefit available to employees with children under 12 years old.[14] These mothers typically work around 30 hours per week. Interestingly, the proportion opting for reduced hours increases, rather than decreases, as their first child ages. This trend likely reflects the growing caregiving responsibilities mothers face, as they often need to leave work early to care for school-age children.

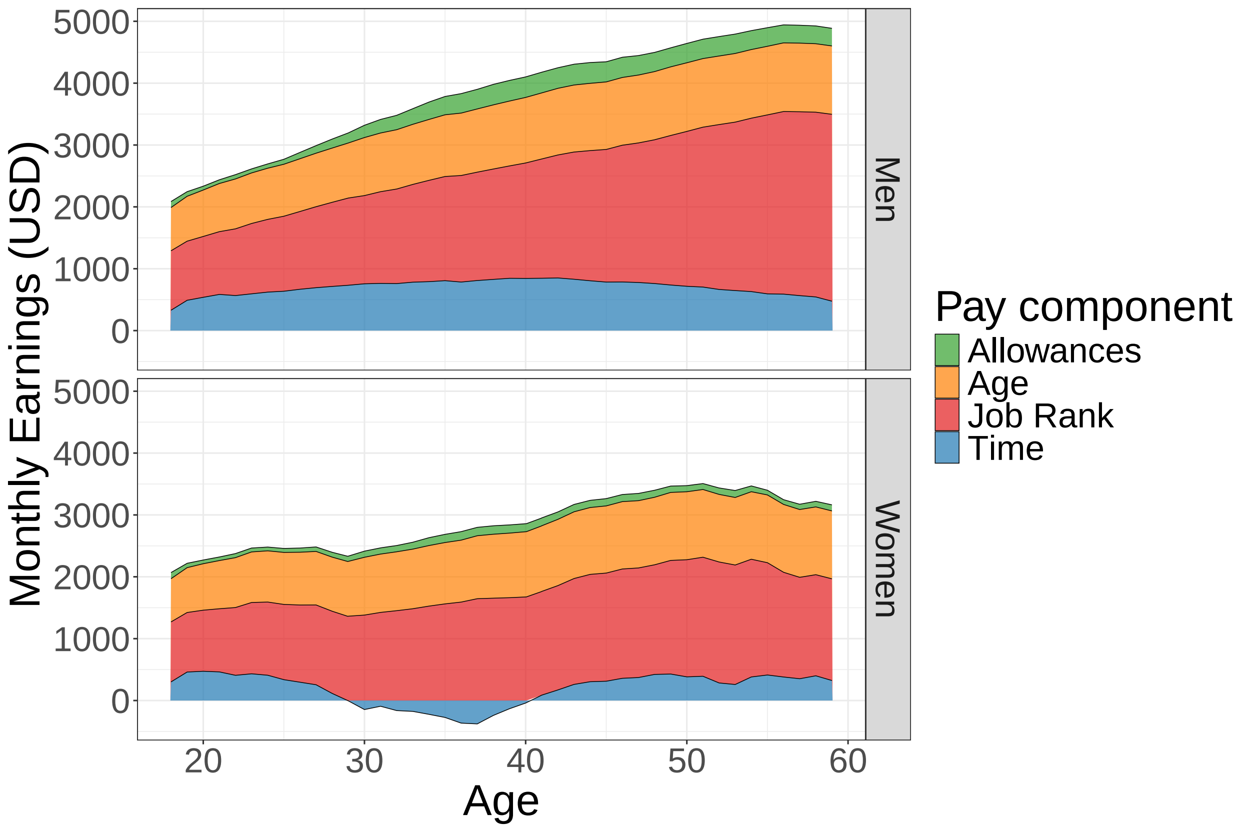


Figure 2: Decomposition of Average Monthly Earnings

Notes: This figure displays the average monthly earnings for age and gender groups, broken down into four pay components. The sample is restricted to male and female employees aged 59 or below who have worked for at least one year at domestic office between September 2013 and January 2024.The upper panel shows All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY.

2.3.3 Within-Firm Earnings Trajectory

Finally, we use detailed pay items from the payroll data to document the sources of the gender earnings gap. In cross section, male employees earn $4,170 per month, while female employees earn $2,730 per month on average. This results in an unconditional, within-firm gender pay gap of 35%. The primary driver of this gap is job-rank-based pay, accounting for 53% ($759) of the pay gap. An additional 21% ($308) is attributed to the gender gap in time-based pay, while allowances explain 16%. The remaining 10% ($140) is attributed to age-based pay, reflecting differences in age between male and female employees.

Dynamically, the gender pay gap widens over the career. Figure 2 shows the average monthly

[14] The share of female workers who have ever opted for reduced work hours is 78%, whereas it is only 0.4% for male workers.

earnings for men and women, broken down into four pay components. Between ages 25 and 50, the gender gap more than doubles, increasing from 11% to 26%. At age 25, nearly 95% of the pay gap comes from differences in time-based pay. By age 50, time-based pay accounts for less than 30%. In contrast, job-rank-based pay explains over 50% of the gap. Women's pay growth within the firm falls short of men's largely due to the lack of growth in rank-based pay.

Women's pay growth significantly correlates with the presence of children. Figure 14 in Appendix A shows the trajectory of monthly earnings for those with children and without children. For women's with children, their time-base pay goes negative during childbearing ages, and pay growth stalls. From age 25 and 50, monthly earnings grow by 30%. In contrast, pay for women without children grows continuously over the career. From age 25 and 50, monthly earnings grow by 36%. These patterns align with previous research, which identifies the gendered effects of childbirth as a major contributor to the overall gender pay gap (Bertrand et al., 2010; Kleven et al., 2021; Bertrand, 2020; Cortés and Pan, 2023). In the following sections, we examine in detail how and why childbirth impacts the earnings trajectories of men and women.

3 Child Penalty

As shown in the earlier section, parenthood is a key factor correlating with women's slower pay growth compared to men within the firm. This section expands on these observations by quantifying the impact of childbirth on total monthly earnings. We explore how the child penalty evolves over time, and decompose it into key pay components: age-based, time-based, job-rank-based pay, and allowances. This analysis sheds light on the evolving nature of the child penalty, thereby offering a comprehensive understanding of the mechanisms.

3.1 Empirical Strategy

We employ a matched-control event study design to quantify the impact of childbirth on monthly earnings from this firm and each pay component.[15,16] The treated units are workers whose first

[15]Recent studies using a matched-control event study design include Goldschmidt and Schmieder (2017); Aneja and Xu (2022); Adams-Prassl et al. (2024a,b); Healy and Heissel (2024). Our regression specification closely follows that of Adams-Prassl et al. (2024b).

[16]Earlier studies on the child penalty, such as Kleven et al. (2019b), employ an event study design where the control group consists of not-yet-treated workers rather than matched controls. In Appendix A.3, we also conduct an event study using not-yet-treated workers as controls. Overall, the estimates from the two event study designs are comparable, indicating that our findings are not driven by the specific choice of event-study design.

child was born after September 2013. Figure 3 displays the raw average monthly earnings and their composition before and after the first childbirth.[17] Women experience a sharp and sustained drop in earnings following childbirth, while mens earnings remain largely unaffected, except for a brief dip in the first month. This divergence widens the father-mother pay gap. To isolate the causal effect of childbirth, we use the event study design to control for other factors that may influence earnings trajectories.

The pool of control units consists of employees who are married but have no children throughout the study period.[18] Childless, married people constitute a suitable candidate for control group because they are similarly at risk of having a child. This approach is particularly relevant in Japan, where 97.6% of children are born within marriage,[19] and 96.5% of married couples express a desire to have a child.[20]

For each treated individual i, we match a control individual using coarsened exact matching (Iacus et al., 2012) based on gender, education, and the month and year of birth. This approach enables that control groups are comparable to treated groups in the joint distribution of observable baseline characteristics. When there is more than one candidate for a control individual, we randomly select one. Each control individual is assigned a placebo childbirth month corresponding to their matched treated individual so that that matched pairs share the same event timing. The resulting dataset consists of equal-sized treated and control groups. Control groups identify the earnings trajectories of men and women in the absence of childbirth.

We then run the following regression (1). Let E_i represent the year and month when employee i had their first child. For employee i of gender g in calendar year t,

$$Y_{it}^g = \sum_{e \neq -10} \alpha_e^g D_{it}^e + \sum_s \sum_k \beta_{k,s}^g Age_{it}^k Educ_i^s + \gamma_i + \delta_t^g + \epsilon_{it}^g \tag{1}$$

where Y_{it}^g is the outcome of interest such as monthly earnings. Earnings are used in levels rather than logs to preserve zero values resulting from leave-taking. $D_{it}^e = 1_{[t-E_i=e]} \times Treat_i$ are event time dummies for treated units, where $Treat_i$ is an indicator variable that takes the value of one for a treated individual and zero for a control individual.[21] The coefficients α_e^g capture the dynamic

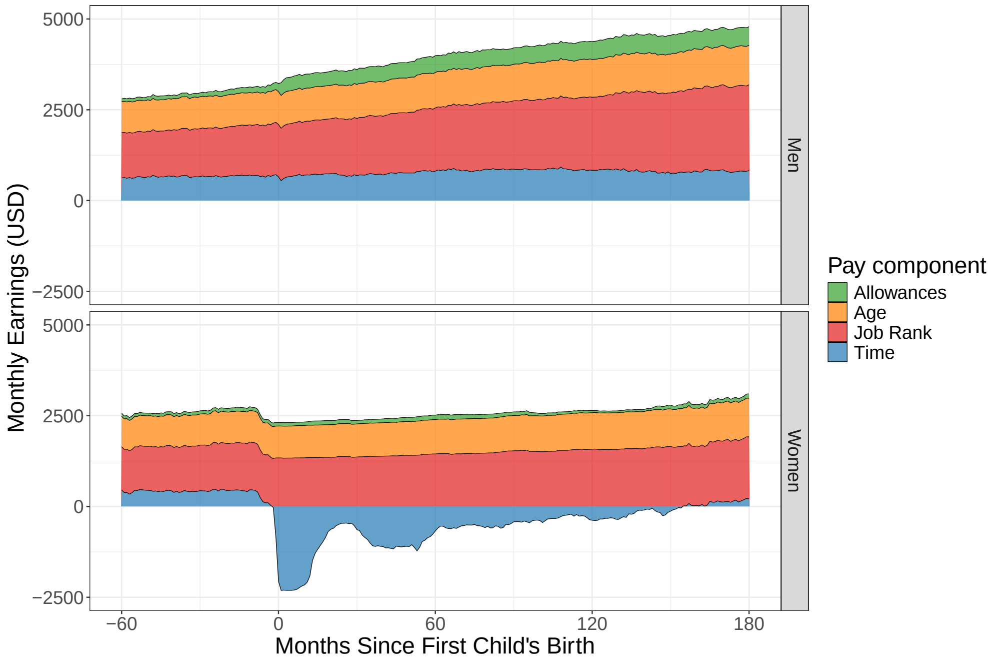
[17] As Figure 3a shows, the decline in women's time-based pay occurs twice: first immediately after their first childbirth and then again around three years later. This pattern aligns with the fact that most parents, both men and women, have more than one child. Appendix A Figure 15 presents a similar figure by the number of children, showing that the second dip does not occur for women with only one child.

[18] See Kleven et al. (2019a) online Appendix B.2 for a discussion of employing pure controls.

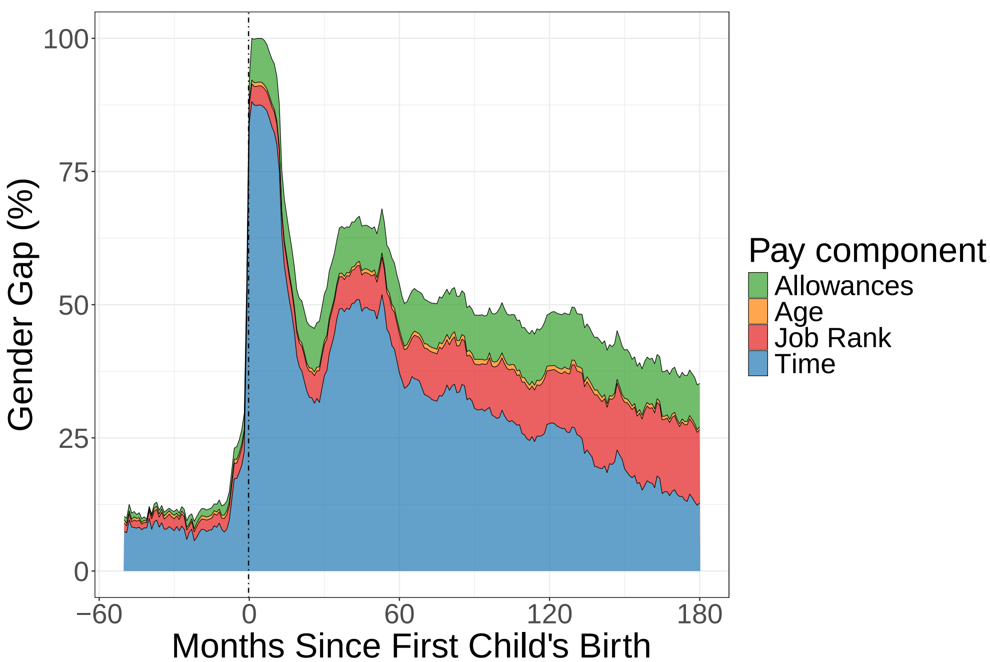
[19] See Vital Statistics 2020.

[20] See Annual Population and Social Security Surveys 2015.

[21] The event time effects for control units are normalized to be zeros in this regression.



(a) Monthly earnings by items and gender



(b) Father-mother gap

Figure 3: Average Monthly Earnings Around the Time of the First Childbirth

Notes: Figure 3a displays the accounting decomposition of average monthly earnings 60 months before and 180 months after the first childbirth. Figure 3b shows the gender pay gap, measured as the difference in average earnings between male and female employees, expressed as a fraction of male earnings. The sample is restricted to employees aged 59 or below who have worked for at least one year at domestic office and have had the first child between September 2013 and January 2024. All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY, which was the average exchange rate in September 2013.

effects of the birth of the first child (i.e., the child penalty). We have interactions of age dummies, $Age^k_{it} = 1_{[k=age_{it}]}$, and education dummies, $Educ^s_i = 1_{[s=Educ_i]}$, allowing for different age-earnings profiles by education and gender.[22,23] The regression also includes individual fixed effects γ_i and gender-specific calendar time fixed effects δ^g_t. The study window spans from 60 months (5 years) before childbirth (or placebo childbirth) to 180 months (15 years) after ($e = [60, \ldots, 180]$), with the timing of conception, $e = -10$, serving as the reference month.

The parameter of interest, α^g_e, represents the impact of childbirth on monthly earnings, relative to ten months before the first childbirth, for individuals who remain with the same firm at event time e. A key assumption for the causal interpretation of α^g_e is a parallel trend assumption: this means that, had they not had children, the trajectory of monthly earnings for employees with children would have been parallel to that of employees without children. Since our earnings measure excludes parental leave benefits — and thus those on parental leave have zero earnings — α^g_e represents the reduction in earned income from productive work at the firm following childbirth.[24]

Following Kleven et al. (2023), we further convert the estimated level effects into percentages using the formula $P^g_e = \alpha^g_e / E[\tilde{Y}^g_{it} | e, Treat_i = 1]$, where $\tilde{Y}^g_{it}$ represents the counterfactual outcome in the absence of childbirth's impact at event time e, i.e.,

$$\tilde{Y}^g_{it} = \sum_s \sum_k \tilde{\beta}^g_{k,s} Age^k_{it} Educ^s_i + \tilde{\gamma}_i + \tilde{\delta}^g_t \tag{2}$$

Finally, we compute the child penalty at event time e as

$$\text{Child Penalty}(\bar{e}) \equiv E[P^{Men}_e | 0 \leq e \leq \bar{e}] - E[P^{Women}_e | 0 \leq e \leq \bar{e}]. \tag{3}$$

The first term represents the percentage effect on men's earnings averaged over $\bar{e}$ months post birth. We refer to it as the fatherhood premium if positive, or the fatherhood penalty if negative. The second term represents the average effects on women's earnings, referred to as the motherhood penalty. The child penalty is then defined as the difference between the fatherhood premium (or

[22]In the conventional event study approach to estimating the child penalty, such as that employed by Kleven et al. (2019a) using Danish register data, skill-specific (education-specific) age-earnings profiles are not accounted for. However, recent research by Adams-Prassl et al. (2024c), also utilizing Danish register data, highlights that fertility and parental leave dynamics vary systematically across skill (education) groups. They emphasize the importance of incorporating skill-specific age-earnings profiles and time-since-graduation factors to better capture these differences. In our analysis, we include skill-specific age-earnings profiles but exclude time-since-graduation due to the high degree of collinearity between age and time-since-graduation.

[23]Controlling for demographic characteristics also helps mitigate potential bias in estimates caused by residual imbalances in covariates from the coarsened matching procedure.

[24]Adams-Prassl et al. (2024c) show that the size of child penalty on earnings significantly differ with and without counting parental leave benefit as earnings.

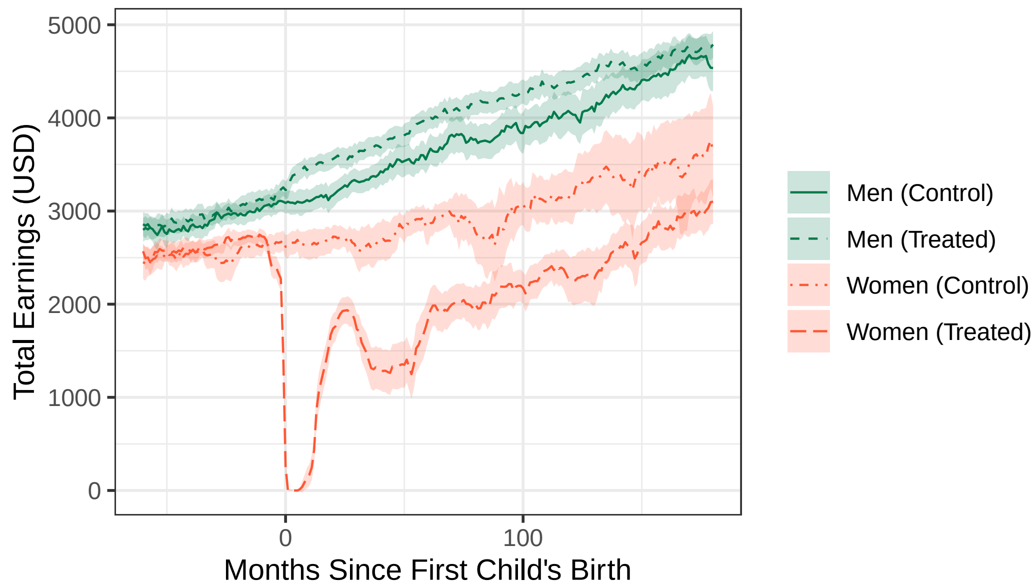


Figure 4: Average Monthly Earnings of Treated and Matched Control Groups

Notes: This figure displays the mean monthly earnings, along with 95% confidence intervals, for men and women with children and their respective matched control groups. All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY.

penalty) and the motherhood penalty.

3.2 Estimation Results

Figure 4 illustrates the mean total monthly earnings for men and women with children (treated group) in our sample, alongside their respective control groups as defined in Section 3.1. The timeline spans from 60 months before to 180 months after the birth of the first child. Before child conception, the earnings trajectories of the treated and control groups align closely, with no statistically significant differences observed. In Appendix A.3, we further demonstrate that pre-event characteristics, such as performance evaluation scores and hours worked, are balanced between the treated and matched control groups. This indicates that, conditional on the worker characteristics used for matching (gender, education, birth cohort, and marital status), there is no statistically detectable selection into childbearing. In contrast, after childbirth, the trajectories diverge, showing the impact of childbirth on earnings: positive for men and negative for women.

Figure 5 presents the event study estimates of the fatherhood premium and motherhood penalty. At the top row, Figure 5a displays the effect on men's total earnings, while Figure 5b shows women's. In both cases, there is no significant pretrend found, which supports the parallel trend assumption.

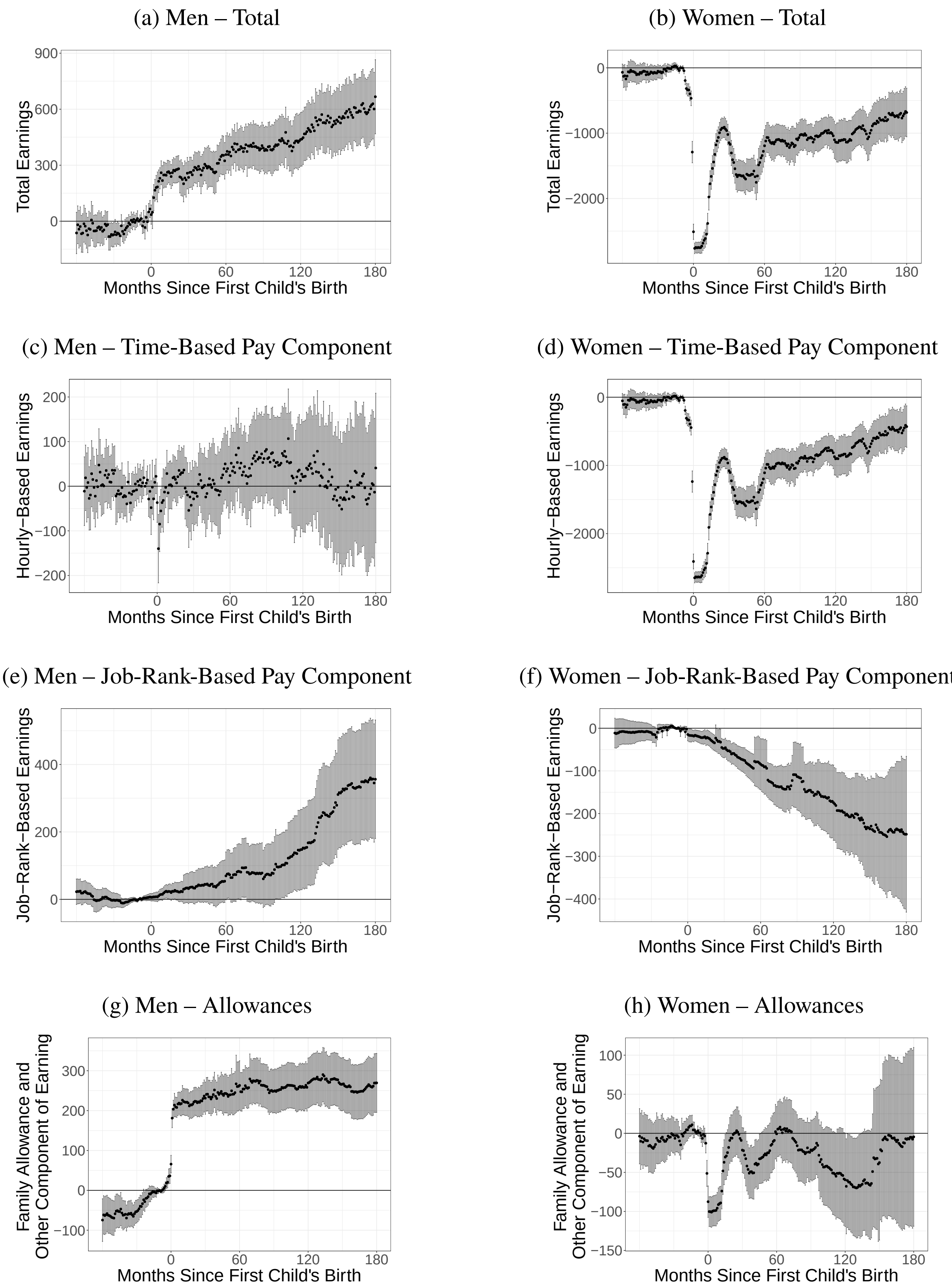


Figure 5: Event Study Estimates by Pay Component

Notes: This figure shows the event study estimates and 95% confidence intervals for the impact of childbirth on monthly earnings by pay component, based on the regression specified in equation (1). The reference month is set at the time of conception ($e = -10$). All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY.

Averaged over the first ten years after childbirth, the long-run child penalty is 55 percentage points. Of this, 8 percentage points are attributed to the fatherhood premium, while the remaining 46 percentage points come from the motherhood penalty.

Our data can further quantify the impact of childbirth on each pay component as shown in the second to the fouth rows of Figure 5. Specifically, Figures 5c and 5d present the event-study estimates for the impact on time-based pay for men and women, respectively. Figures 5e and 5f display the effects on job-rank-based pay, while Figures 5g and 5h illustrate the impact on allowances. No significant pre-trend is observed for any pay component except for allowances for men,[25] further supporting our identification strategy. These estimates help us to breakdown the fatherhood premium and motherhood penalty.

We break down the fatherhood earnings premium. Unlike findings from studies in the US (Lundberg and Rose, 2000), the premium in this paper is not driven by an increase in hours worked, rejecting the idea of within-household specialization. As shown in 5c, the arrival of a child has little effect on time-based pay, except for a small but noticeable drop in the first few months after childbirth. Instead, Figure 5g reveals an immediate, significant, and persistent positive impact on allowances at the time of childbirth. This increase is largely automatic, driven by the *family allowance*, which is common in Japanese firms. The allowance provides additional compensation to household heads, with the amount increasing as family size grows. As discussed in Section 2.2, while the family allowance is *de jure* (by law) gender-neutral, it is *de facto* (in practice) gendered, as male employees are almost always considered household heads. As shown in Figure 5e, job-rank-based pay shows no short-term effect, but positive impacts emerge in the long run.

Interestingly, the sources of the motherhood penalty change over time. As shown in Figure 5d, time-based pay declines sharply after childbirth, initially accounting for nearly the entire motherhood penalty. Because our payroll data is recorded monthly, we capture the steep earnings drop when mothers take parental leave. While earnings gradually recover within two years, they dip again, likely due to about half of the mothers having a second child.[26] Data on parental leave and reduced hours usage, as shown in Figure 1, support this pattern. After 60 months, the reduction in time-based pay begins to steadily diminish. Meanwhile, job-rank-based pay experiences a smaller but noticeable decline immediately after childbirth, which grows steadily over time. This pattern contrasts with findings from previous studies using registry data, which report an immediate and

[25]The small pre-trend observed a year before conception arises from a higher proportion of treated men getting married during this period, which increases the amount of family allowance. We are unable to match treated and control groups by the year of marriage because data on the exact year of marriage are not available for all individuals.

[26]Figure 13 in Appendix A.2 shows the distribution of the number of children among male and female workers at the firm.

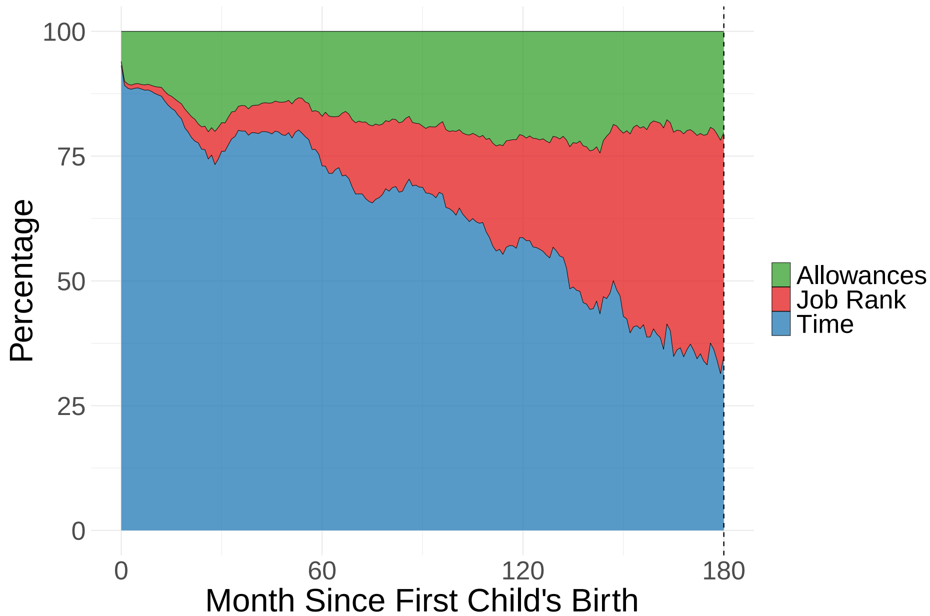


Figure 6: Sources of Child Penalty

Notes: This figure shows the relative contributions of pay components, time, rank and allowances, to the child penalty. The estimates are derived from the regression specified in equation (1).

significant drop in occupational rank and promotion opportunities following childbirth (Kleven et al., 2019b; Bronson and Thoursie, 2021).

Combining the fatherhood premium and the motherhood penalty, Figure 6 illustrates the changing shares of the sources of the child penalty up to 15 years after childbirth. Time-based pay initially accounts for nearly 90% of the penalty, consistent with women's leave-taking patterns (Section 2.3.2). This coincides with increased family care responsibilities: employee surveys reveal a 70-percentage point rise in female employees needing work accommodations after their first childbirth (detailed in Appendix A.4). However, the relative importance of these factors shifts over time. By year 10, time-based pay's contribution decreases to 60%, while job-rank-based pay accounts for 17%. Beyond this point, the impact of rank-based pay increases significantly, becoming the largest contributor to the penalty by year 15. This evolution suggests that understanding the long-term child penalty requires examining the mechanisms behind the growing rank component, particularly promotions and job evaluations, which we address in the next section.

Table 2: Unconditional Promotion Rate by Gender

Promotion	Men	Women	Gender Gap	p-value	Relative rate
Staff Member to Team Leader	0.05	0.02	0.04	0.00	0.35
Team Leader to Senior Team Leader	0.08	0.09	-0.01	0.75	1.09
Senior Team Leader to Manager	0.07	0.05	0.02	0.19	0.72

Notes: This table reports the unconditional, annual promotion hazard by sex at each job rank. Relative rate is defined as women's promotion rate divided by men's rate.

4 Underlying Mechanisms

Our previous analysis demonstrated that rank-based pay differences are a key determinant of the long-term child penalty. Understanding the mechanisms through which childbirth affects rank-based pay, i.e., promotion prospects, is therefore crucial for explaining both the existence and magnitude of the penalty. We begin in Section 4.1 by quantitatively examining how working hours and performance evaluations influence promotion decisions, showing that these factors create particular challenges for mothers. In Section 4.2, we then evaluate other potential mechanisms that could explain the relationship between childbirth and slower promotion trajectories.

4.1 Internal Promotion Dynamics

4.1.1 Promotion Decision

A significant gender gap in promotions emerges early in the career ladder. Table 2 presents the unconditional annual promotion rates by gender, showing that men are promoted from staff member to team leader at 4.5% annually, more than double the 1.8% promotion rate for women. Although this gender promotion gap narrows at higher ranks, women remain significantly underrepresented in the upper echelons of the firm.

Figure 7 illustrates the distribution of women across three non-managerial positions (staff member, team leader, and unit leader) and one managerial position (section manager). The data clearly show that most women are concentrated at the lowest level of the career ladder, while many men occupy higher positions. This distribution aligns with the "broken rung" phenomenon observed in many organizations (McKinsey and LeanIn, 2019).

Our interview with the firm's HR department revealed the promotion decision process. Promotions are made solely based on recommendations from supervisors. The immediate supervisor

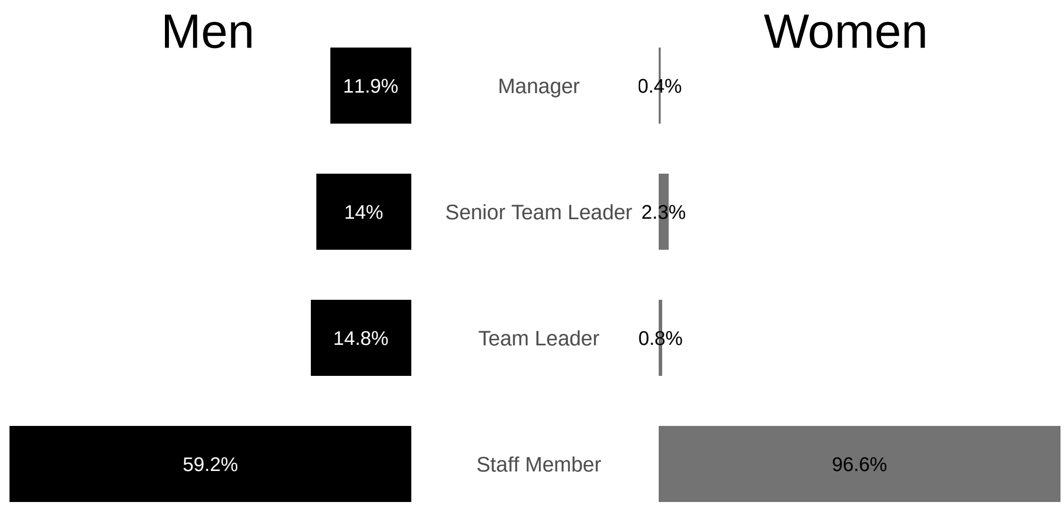


Figure 7: Distribution of Men and Women Across the Job Ladder

Notes: This figure shows the percentage distribution of employees across job ranks, separately for men and women. The job ranks include Staff Members at the entry level, followed by Team Leaders and Senior Team Leaders, which are non-managerial positions. Section Managers represent the first managerial rank. The sample is limited to employees working in domestic offices as of September 2013. Employees above the Section Manager rank are excluded from this figure.

assesses their subordinates based on performance, teamwork, and leadership potential. Reflecting cultural norms in Japanese firms, collaborative skills are highly valued, while individual output is given less emphasis. These assessments are generally reflected in the annual evaluation score by immediate supervisors, which must be approved by supervisors two levels above in the organizational hierarchy. Although employees have no opportunity to apply for promotion, they can express their career aspirations in a one-on-one meeting, which is recorded in the annual employee survey.

To understand how these qualitative assessments translate into promotion decisions, we examine the relationship between performance scores and promotion rates. Figure 8 shows the average annual promotion rate by performance evaluation score from the previous year. For each job rank, the promotion rate increases with performance scores. Achieving the highest score (5) increases the likelihood of promotion by a factor of three to five compared to the second-highest score (4). These statistics indicates that the current promotion system assigns higher performers to higher ranks, confirming the HR department's explanation.

While performance scores play a crucial role in promotions, we also examined the potential influence of working hours. The HR department notes that working hours are not officially considered in promotion decisions, as the ability to work longer is not a prioritized quality. Figure 9 presents the distribution of weekly hours worked across three non-managerial positions: staff member, team

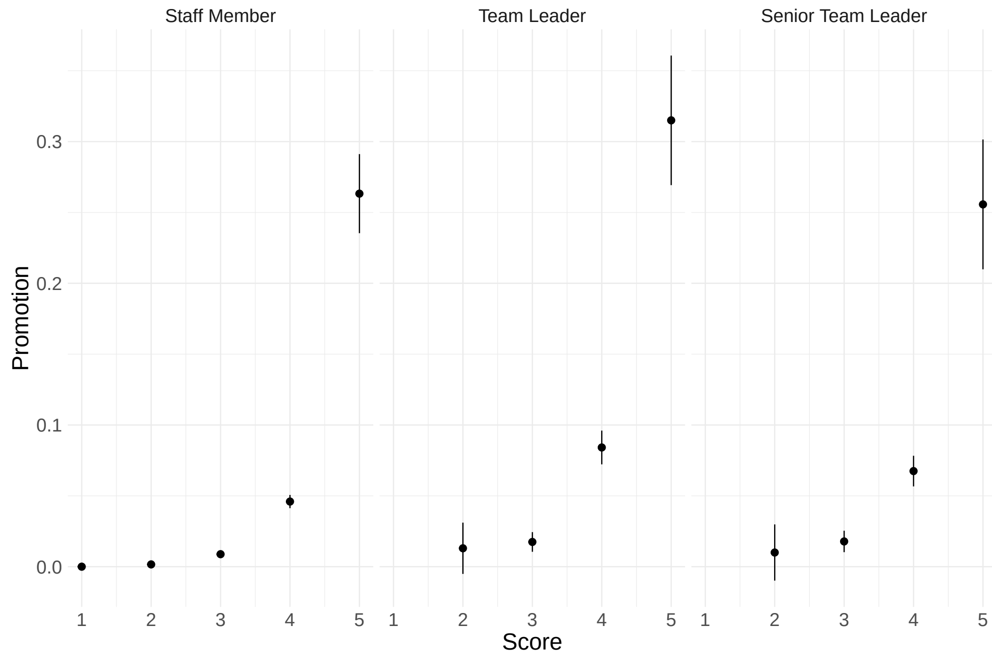


Figure 8: Promotion Rate by Evaluation Score and Job Rank

Notes: This figure shows the average annual promotion rate by evaluation score and job rank, based on data from 2013 to 2023. The sample includes employees who worked for at least one year in domestic offices during these years.

leader, and unit leader. Although team and unit leaders on average work longer hours than staff members, these leaders do not necessarily work beyond 50 hours per week. In fact, some leaders work less than 40 hours per week. However, HR reports that supervisors often informally favor employees who work longer hours or take on unconventional shifts, such as night shifts. The extent to which this unofficial preference influences internal promotions, however, remains unclear.

To empirically assess the influences of performance evaluation scores and hours of work, as well as other demographic characteristics, we run a regression model for promotion. This model examines the factors affecting an employee's likelihood of moving up by one rank, as described in Section 2.2. Specifically, for employee i at the rank r in the division s in year t,

$$promote_{i,r,s,t+1} = \sum_j \beta_j^r \cdot \mathbf{D}_{i,t}^j + \sum_h \lambda_h^r \cdot \mathbf{D}_{i,t}^h + \theta_p^r \mathbf{D}_i^{female} + \tau_t^r + \delta_s^r + x'_{i,s,t}\gamma^r + \epsilon_{i,r,s,t} \quad (4)$$

where $promote_{i,r,s,t+1}$ is an indicator of promotion from rank r to $r+1$ for worker i at division s in year $t+1$. The variable $\mathbf{D}_{i,t}^j$ $(j = 1, 2, 4, 5)$ is a dummy variable indicating whether an employee's evaluation score, rounded to the nearest integer, is $j = 1, 2, 4$, or 5. Score 3 is the omitted category. The variable $\mathbf{D}_{i,t}^h$ is a dummy variable indicating whether an employee works shorter hours (less than 40 hours per week) or longer hours (more than 50 hours per week). Regular working hours

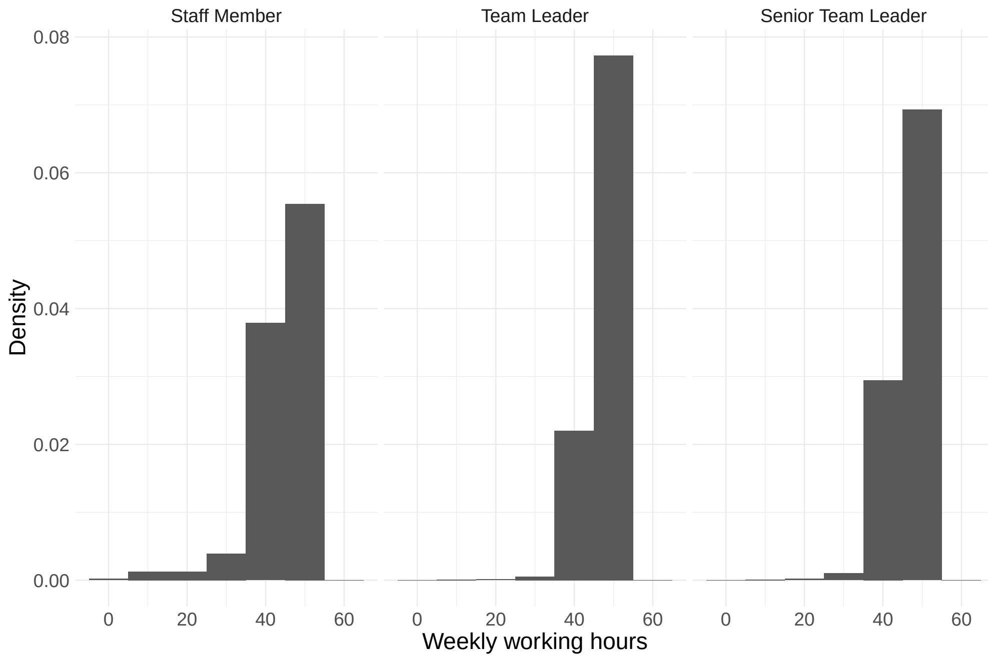


Figure 9: Distribution of Weekly Hours Worked by Job Rank

Notes: This figure shows the distribution of average weekly hours worked by job rank, based on pooled data from 2013 to 2023. The sample includes employees who worked for at least one year in domestic offices during this period.

(40-50 hours per week) serve as the reference category. The variable $\mathbf{D}_i^{female}$ is a female dummy, τ_t^r is a time fixed effect, δ_s^r is a division fixed effect, and $x_{i,s,t}$ is a vector of i's other characteristics including educational attainment, age, and recruitment channels through which i was hired. The last term $\epsilon_{i,r,s,t}$ is an error term uncorrelated with all other variables.

Table 3 reports the results.[27] At each step of promotion, there is a significant, positive, non-linear relationship between the evaluation score and the promotion rate. Column 1 shows that compared to score 3, achieving the highest score (i.e., 5) increases the chance of promotion from staff member to team leader by 24 percentage points. Similarly, Column 2 shows that it increases the chance of promotion from team leader to unit leader by 29 percentage points, while Column 3 indicates a 26 percentage point increase for promotion from senior team leader to section manager. Consistent with HR's description, hours worked have no impact on promotion probability when evaluation score is given, except for a small negative effect of short working hours at the entry rank.

Having a child does not affect the probability of promotion for women. However, regardless of parenthood status, being female reduces the likelihood of promotion from staff member to team leader by 4 percentage points. This gender gap is equivalent to the impact of a reduction in eval-

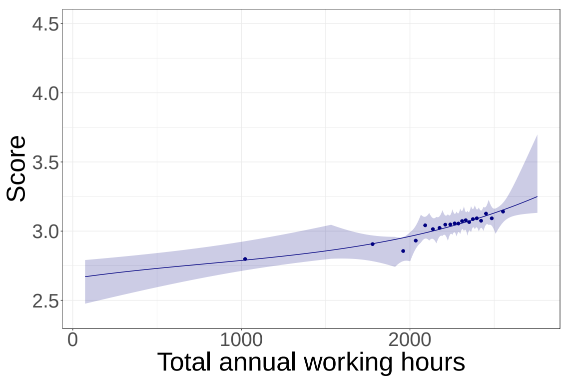
[27]In Appendix A.5, we present the results from running the regression separately for each division.

uation scores from 4 to 3, indicating a potential unexplained barrier for women in the promotion process. While this study focuses on the child penalty within the firm, our findings do not rule out the possibility that factors beyond the child penalty also contribute to the overall gender gap within the organization.

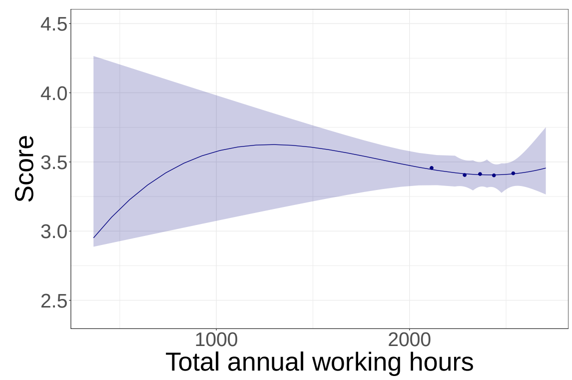
Table 3: Determinants of Promotions

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	−0.04	−0.04	−0.02	−0.03	−0.02	−0.03
	(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.02)
Evaluation score (ref. 3)						
5	0.24	0.24	0.29	0.28	0.26	0.26
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
4	0.04	0.04	0.07	0.07	0.06	0.05
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
2	−0.01	−0.01	−0.01	0.00	−0.02	−0.01
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
1	0.00	0.00				
	(0.01)	(0.01)				
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**						
≥ 50 hours	−0.00	−0.01	0.00	0.00	−0.00	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
< 40 hours	−0.01	−0.01	0.03	0.04	0.04	0.02
	(0.00)	(0.00)	(0.03)	(0.04)	(0.02)	(0.03)
Top		0.01		0.00		0.00
		(0.01)		(0.01)		(0.01)
Education (ref. High school)						
4-Yr College	0.00	0.00	0.04	0.03	0.02	0.02
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Some College	0.00	−0.01	0.09	0.08	0.03	0.03
	(0.01)	(0.01)	(0.04)	(0.06)	(0.02)	(0.03)
Mid Carrer	−0.01	−0.01	−0.02	−0.02	−0.04	−0.04
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Age	0.01	0.01	0.04	0.04	0.07	0.08
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	0.04	0.04	0.08	0.08	0.07	0.06
Num.Obs.	18 349	17 819	4020	3504	3660	3081
R2 Adj.	0.114	0.111	0.117	0.110	0.092	0.100
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Division	X	X	X	X	X	X
FE: Period	X	X	X	X	X	X

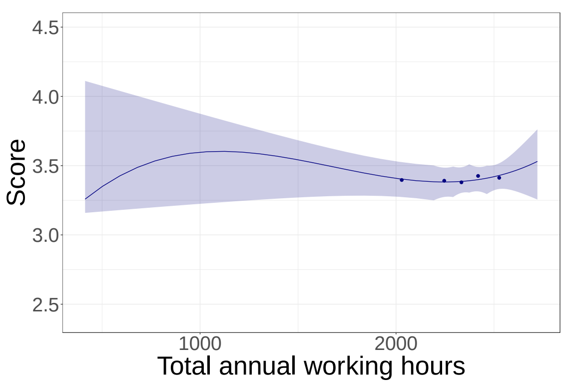
Notes: This table presents the results from regressing promotion incidence on worker characteristics, as specified in regression equation (4). The regressions are run with and without an indicator variable identifying whether a worker has the longest tenure in their work unit. The sample includes workers from all divisions combined. The first two columns report results for all staff members, the next two focus on team leaders, and the final two on senior team leaders. All specifications include division and year fixed effects. Standard errors, clustered at the worker level, are shown in parentheses.



(a) Staff Member



(b) Team Leader



(c) Senior Team Leader

Figure 10: Hours Worked and Evaluation Scores

Notes: This binscatter plot illustrates the relationship between annual hours worked (x-axis) and annual evaluation scores (y-axis), following the methodology of Cattaneo et al. (2024). The optimal number of bins is determined by minimizing the integrated mean square error (IMSE), using the default settings in the *binsreg* package. The blue line represents a third-order polynomial fit, with shaded regions indicating 95% confidence intervals. All estimates control for division fixed effects.

4.1.2 Performance Evaluation

Given that performance evaluations are crucial for promotion, as evidenced by our previous analysis, we next examine the determinants of evaluation scores. In particular, we are interested in understanding how working hours are associated with these scores, especially because our interviews with HR suggested that long hours are informally favored. This analysis will help us further unpack the mechanisms behind the promotion patterns we observe.

To see how hours of work is associated with evaluation scores in a simple framework, we apply the binscatter method proposed by Cattaneo et al. (2024). Here, we control for division fixed effects because evaluation criteria differ substantially by divisions, according to HR. As shown in

Figure 10a, hours worked and evaluation scores are positively correlated at the lowest job rank (staff member). This association, however, disappears at the higher ranks (see Figures 10b and 10c).

We also run the following regression model for performance evaluation with more control variables. Specifically, for employee i at the rank r in the division s in year t,

$$eval_{i,r,s,t} = \sum_h \lambda_h^r \cdot \mathbf{D}_{i,t}^h + \theta_p^r \mathbf{D}_i^{female} + \tau_t^r + \delta_s^r + x'_{i,s,t}\gamma^r + \epsilon_{i,r,s,t} \tag{5}$$

where $eval_{i,r,s,t}$ is i's evaluation score in year t. The variable $\mathbf{D}_{i,t}^h$ is a dummy variable indicating whether an employee works shorter hours (less than 40 hours per week) or longer hours (more than 50 hours per week). Regular working hours (40-50 hours per week) serve as the reference category. The variable $\mathbf{D}_i^{female}$ is a female dummy, τ_t^r is a time fixed effect, δ_s^r is a division fixed effect, and $x_{i,s,t}$ is a vector of i's characteristics including educational attainment, age, and recruitment channels through which i was hired. The last term $\epsilon_{i,r,s,t}$ is an error term uncorrelated with all other variables.

Table 4 presents the results.[28] At the lowest rank (staff member), there is a significant, positive, and non-linear relationship between hours worked and evaluation scores. Column 1 shows that long working hours are associated with a 0.07 point higher evaluation score than regular working hours. Conversely, short working hours are associated with a 0.20 point lower score than regular working hours. Interestingly, for team leaders (Column 2) and senior team leaders (Column 3), hours worked no longer show a statistically significant association with evaluation scores. Finally, the coefficient for the female dummy is positive and statistically significant, indicating that women perform better than men with the same work hours at the same hierarchical level, even though women's higher scores do not necessarily lead to more promotions, as we have shown in the previous subsection.

[28] In Appendix A.6, we present the results from running the regression separately for each division.

Table 4: Determinants of Evaluation Scores

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	0.05	0.06	0.02	−0.05	−0.04	−0.06
	(0.02)	(0.02)	(0.07)	(0.07)	(0.06)	(0.06)
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**						
≥ 50 hours	0.07	0.06	0.03	0.04	0.03	0.00
	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
< 40 hours	−0.20	−0.19	0.11	0.08	0.00	−0.04
	(0.02)	(0.02)	(0.08)	(0.09)	(0.05)	(0.06)
Top		0.07		−0.01		0.04
		(0.02)		(0.02)		(0.03)
Education (ref. High school)						
4-Yr College	0.13	0.12	0.09	0.09	0.05	0.05
	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
Some College	0.16	0.15	0.01	−0.09	0.04	0.03
	(0.06)	(0.06)	(0.12)	(0.11)	(0.10)	(0.10)
Mid Carrer	0.04	0.04	0.15	0.16	0.10	0.11
	(0.02)	(0.02)	(0.05)	(0.05)	(0.05)	(0.05)
Age	−0.00	−0.00	0.05	0.05	0.01	0.02
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(0.04)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	3.38	3.37	3.63	3.62	3.67	3.65
Num.Obs.	18 349	17 819	4020	3504	3660	3081
R2 Adj.	0.201	0.196	0.097	0.085	0.146	0.137
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Division	X	X	X	X	X	X
FE: Period	X	X	X	X	X	X

Notes: This table presents the results of regressions analyzing annual evaluation scores based on worker characteristics, as specified in regression equation (5). The regressions are run with and without an indicator variable identifying whether a worker has the longest tenure in their work unit. The sample includes workers from all divisions combined. The first two columns report results for all staff members, the next two focus on team leaders, and the final two on senior team leaders. All specifications include division and year fixed effects. Standard errors, clustered at the worker level, are shown in parentheses.

4.2 Discussion

Our analysis in Section 4.1 identifies working hours as a critical pathway through which childbirth affects promotion prospects: increased caregiving responsibilities following childbirth constrain mothers' time allocation at work, which subsequently impacts their career progression. This finding raises two questions. First, we investigate why working hours are so crucial for career advancement in our setting (Section 4.2.1). Our evidence strongly supports compensating differentials as the primary mechanism, while showing that tournament incentives might play a complementary role. We find limited support for alternative explanations based on signaling or human capital accumulation. Second, we consider whether mechanisms beyond the hours-evaluation-promotion channel might explain the child penalty (Section 4.2.2). We find limited empirical support for explanations based on managerial bias against mothers or changes in women's career aspirations following childbirth. These findings suggest that gendered time constraints after childbirth, rather than a priori bias or changes in aspirations, drive the motherhood penalty identified in Section 3.2.

4.2.1 Extended Hours and Career Advancement: Assessing Alternative Mechanisms

Our analysis in Section 4.1 reveals a strong empirical relationship between working hours and career advancement within the firm. This pattern, while documented in our single-firm setting, reflects a broader phenomenon observed across various contexts, from the United States (Bell and Freeman, 2001; Goldin, 2014) and Germany (Bell and Freeman, 2001) to Denmark (Frederiksen et al., 2024).[29] The widespread nature of this relationship suggests that our findings may have broader relevance. Below, we examine four potential mechanisms that could explain how long hours translate into career success. Our evidence strongly supports compensating differentials as the primary mechanism, while providing limited support for alternative explanations based on tournament incentives, signaling, or human capital accumulation.

The primary mechanism supported by our evidence is compensating differentials (Rosen, 1986a; Goldin and Katz, 2011; Goldin, 2014) — premiums paid to workers who maintain extended availability and in-person presence, particularly at entry-level positions. This requirement stems from

[29] Using Danish registry data, Frederiksen et al. (2024) document population-wide evidence of a positive association between work hours and career success in Denmark. They examine the mechanisms linking hours to career outcomes. Their data support multiple explanations: tournament theory, asymmetric information about workers' costs of long hours, and human capital accumulation. They also find that long working hours matter for career progression only within the same firm, not when switching firms. Compared to Frederiksen et al. (2024), we use internal records including production outputs, detailed job ranks beyond the manager/non-manager distinction, work hours, evaluations, and qualitative interviews with the HR department. These data allow us to further narrow down the potential mechanisms linking long hours to career progression.

the need to address time-sensitive situations: sales staff must respond to urgent client requests involving perishable products, while manufacturing workers address unexpected demand surges or mechanical problems. While such events are infrequent, their potential costs make employee preparedness particularly valuable. Notably, these contingency responsibilities primarily affect entry-level positions rather than team leaders, whose main role is staff supervision. The firm addresses this technological constraint through two compensation channels: direct overtime pay and (more importantly) the promise of higher future earnings through better evaluation scores and promotion prospects.

While the compensating differentials explanation aligns well with our empirical patterns and institutional context, we systematically examine alternative explanations for two reasons. First, it helps validate our interpretation that the hours-evaluation link reflects technological constraints rather than other factors. Second, different mechanisms could have distinct implications for both the efficiency of current practices and potential policy interventions. We consider three alternative explanations.

The first alternative mechanism operates through human capital accumulation: longer working hours could build skills through learning-by-doing, leading to higher future productivity (Shaw, 1989; Imai and Keane, 2004). If this mechanism explains our findings, we would expect employees who work longer hours to become more productive over time, which would justify their higher evaluation scores. While we cannot directly observe individual productivity, we can test this hypothesis using team-level data. Specifically, we examine whether teams whose non-managerial employees work longer hours in year $t-1$ produce more hourly output in year t, controlling for year and workplace fixed effects. Our analysis, detailed in Appendix A.8, finds no significant relationship between past working hours and current productivity. This evidence suggests that productivity enhancement through learning-by-doing is not likely to explain the relationship between working hours and evaluation scores.

Signaling theory (Spence, 1973) suggests that early-career employees might use long working hours to signal their ability and leadership potential. According to this explanation, evaluators would interpret extended hours as a proxy for leadership qualities, rewarding these workers with better evaluations. However, our evidence is not consistent with the signaling mechanism: we find that working hours do not correlate with performance evaluations at upper ranks (Section 4.1.2). This lack of correlation suggests that the ability to work long hours does not predict leadership effectiveness, making it unlikely that working hours serve as a meaningful signal of worker quality in our context.

Our evidence also supports a complementary role for tournament incentives. Tournament theory suggests that promotion and reward systems operate as rank-order tournaments where workers compete based on relative rather than absolute performance (Lazear and Rosen, 1981; Rosen, 1986b). Tournament theory is particularly relevant in corporate settings, helping explain the substantial pay premiums at higher ranks. If tournament dynamics drive our findings, relative working hours among peers should be more predictive of evaluation scores than absolute hours worked. To test this prediction, we modify regression (5) to include an indicator for whether an employee works the longest hours within their peer group (defined as those at the same job rank under the same supervisor). Our analysis shows that while being the longest-hours worker carries a significant additional premium in evaluation scores, the baseline relationship between absolute hours and evaluations remains the same (see Table 3). These results suggest tournament incentives may complement rather than replace our primary mechanism — evaluators appear to reward both absolute effort and relative performance. This complementarity aligns with HR's observation that the firm faces scarcity of talent for high-ranked positions.

In summary, our evidence suggests that compensating differentials — the need to handle time-sensitive contingencies creates fundamental demands for extended availability, particularly at entry-level positions. The firm addresses this technological constraint by rewarding availability through both evaluation scores and promotion decisions. This mechanism helps explain why reduced working hours following childbirth disproportionately affect early-career advancement: the ability to maintain extended presence is most valuable precisely when women face increased family demands.

4.2.2 Examining Other Potential Drivers of the Child Penalty: Discrimination and Career Aspirations

Our analyses in Section 4.1 identify working hours as a critical pathway through which childbirth affects promotion prospects: increased caregiving responsibilities following childbirth constrain mothers' time allocation at work, which subsequently impacts their career progression. Specifically, we find that promotion and evaluation practices rewarding extended hours create barriers to advancement that disproportionately affect women with childcare responsibilities.

We consider two alternative explanations that might explain the child penalty, but find limited empirical support for either in our data. First, supervisors might hold a priori prejudice against mothers, resulting in lower performance evaluations and fewer promotions. However, when we include an indicator for having children in our regression analysis of evaluation scores (detailed in Appendix A.7), we find no evidence that motherhood negatively affects performance assessments.

While women face lower promotion rates for a given evaluation score, this gender gap remains constant before and after childbirth, suggesting discrimination against mothers does not drive the child penalty.

Second, the arrival of a child might fundamentally change women's career aspirations, leading them to reduce their work hours and voluntarily step back from advancement opportunities. Our analysis of employee survey data (detailed in Appendix A.4), however, reveals no significant changes in women's stated career aspirations following childbirth.

These findings suggest that gendered time constraints after childbirth, rather than bias or changing aspirations, drive motherhood penalties in within-firm career advancement — the main source of long-run child penalties identified in Section 3.2. While our conclusions derive from one firm's detailed records and cannot speak to potential discrimination in the broader labor market, we highlight that organizational practices linking extended working hours to career advancement can generate substantial gender gaps even in the absence of explicit bias.

These findings raise important questions about the efficiency implications of current promotion practices. While the firm's emphasis on long hours at entry-level positions may serve legitimate operational needs, it could lead to systematic misallocation of talent when combined with gendered constraints on time allocation. To formally explore these efficiency implications, the next section provides a theoretical framework that incorporates our empirical findings on promotion dynamics.

5 Theoretical Exploration

Building on our empirical findings, we now investigate a theoretical model to explore the efficiency implications of the firm's current evaluation and promotion practices. Our analysis in the previous section revealed the following key patterns:

1. Promotions are mainly based on performance evaluation scores.
2. At the entry level, longer working hours are associated with higher evaluation scores. The association between hours worked and evaluations diminishes at higher ranks.

These patterns suggest that while working long hours may not be crucial for career advancement in the long run, it appears to be essential for getting started on the promotion track. In this section, we analyze an illustrative model of internal promotion that incorporates these empirical regularities.

By modifying the model of Gibbons and Waldman (1999) to step-by-step promotion opportunities, we demonstrate that even in a simple model under full information and no taste-based or other a priori gender bias, these evaluation and promotion practices themselves can cause production and Pareto inefficiency. We then discuss implications to the long-run child penality by focusing on gender differences in post-childbirth time constraints.

Consider a model with a unit mass of female workers and a unit mass of male workers in a firm. Each worker has two traits: *utility cost of working* $\beta_i > 0$ which is potentially gender-specific as we discuss later, and *innate ability* θ_i drawn from a uniform distribution over $[\underline{\theta}, \overline{\theta}]$ where $\overline{\theta} > \underline{\theta} > 0$. For simplicity and to solely highlight the implications from a promotion policy, we assume that θ_i is independently distributed across gender and observable to all parties.

There are three periods following childbirth, $t = 1, 2, 3$. A firm consists of three-rank job ladders, $j = 1, 2, 3$. If worker i is assigned to job rank j in period t, then the worker produces outputs $y_{i,t} = d_j + c_j \eta_{i,t}$, where d_j and c_j are known to all parties. We assume that $d_1 \geq d_2 \geq d_3 \geq 0$ and $c_3 \geq c_2 \geq c_1 \geq 0$.[30] We also assume that workers are paid at their own productivity (evaluated by the firm), i.e., $w_{i,j,t} = d_j + c_j \eta_{i,t}$ where $\eta_{i,t}$ represents worker i's human capital (evaluated by the firm) in period t, as defined in the next paragraph.

Each worker i is endowed with the initial productivity $\eta_{i,1} = \theta_i$ and assigned to job 1 (entry rank) at the beginning of period 1. Given $\eta_{i,t}$ and period-t job rank denoted by $j(t)$, each worker chooses hours worked $h_{i,t} \geq 0$. Then, worker i's (cumulative) evaluation score on the job according to one's own ability and hours worked in period t is updated to:

$$\eta_{i,t+1} = \eta_{i,t} + \theta_i + \mathbf{1}_{j(t)=1} h_{i,t}.$$

Because all workers are assigned to job 1 at the beginning of period 1, $\eta_{i,2} = 2\theta_i + h_{i,1}$ for any i. The firm's promotion rule at the end of period $t = 1, 2$ is to assign worker i from job 1 to job 2 (team leader) if and only if $\eta_{i,t+1} \geq \eta_1$, and to assign worker i from job 2 to job 3 (senior team leader) if and only if $\eta_{i,t+1} \geq \eta_2$, where η_1 and η_2 are exogenously-given thresholds with $\eta_2 > \eta_1 > \overline{\theta}$.[31]

Four remarks are in order. First, consistent with Fact 1, worker i's productivity is increasing in

[30] For the solution of the utility maximization (which is introduced later) to be well-defined, we also assume that $\beta_i > 2c_1$, $\beta_i(\beta_i - c_1) > 2c_2^2$, and $\beta_i^2 > c_2^2 + c_3^2$.

[31] Different from existing models such as Gibbons and Waldman (1999), Gicheva (2013), Kato et al. (2017), and Bronson and Thoursie (2021), there is a friction on promotion steps: each worker faces the same promotion thresholds and cannot be promoted from job 1 to job 3 within one period. For this friction, we assume that workers can neither negotiate with a company nor find an outside position with a higher-ranked job. Consistent with this assumption, there is essentially no wage negotiation in these (non-top) job ranks in the firm. Furthermore, hiring a worker for a middle or high-rank position is exceptional.

one's own ability. Second, reflecting Fact 2 that long working hours are appreciated only for the lowest-rank job, worker i's evaluation score is increasing in one's own labor input only for $j = 1$. Third, if a worker is not promoted in period 1, then the worker cannot be promoted to the highest rank ($j = 3$), which potentially leads to a broken rung as we discuss later. Fourth, because each worker's wage is assumed to be paid at her/his production, each worker receives all of the production surplus. Hence, production efficiency (together with each worker's utility maximization, as defined in the next paragraph) implies Pareto efficiency in our model.

Worker i's utility consists of consumption and home production. We assume that it takes the following form:

$$U(\theta_i, \beta_i) = \left(w_{i,j(1),1}h_{i,1} - \frac{1}{2}\beta_i h_{i,1}^2\right) + \left(w_{i,j(2),2}h_{i,2} - \frac{1}{2}\beta_i h_{i,2}^2\right) + \left(w_{i,j(3),3}h_{i,3} - \frac{1}{2}\beta_i h_{i,3}^2\right).$$

Each worker chooses their labor inputs $(h_{i,1}, h_{i,2}, h_{i,3})$ to maximize their own utility. Note that if each $\eta_{i,t}$ were exogenously fixed, the optimal labor input would be $h_{i,t} = w_{i,j,t}/\beta_i = (d_j + c_j \eta_{i,t})/\beta_i$, which we call effective productivity of worker i.

In Appendix C, we derive the worker's optimal decision by solving the maximization problem and provide the proofs of the following propositions. Figure 11 illustrates the optimal household behavior depending on θ_i and β_i. Note that the worker is more likely to be promoted to a higher job rank, as one's ability (θ_i) increases or the marginal disutility of labor (β_i) decreases.

Now, we focus on a situation in which female workers bear higher marginal cost of working than male workers due to higher childcare responsibilities, i.e., $\beta_{female} > \beta_{male}$ (consistent with the fact shown in Figure 18a). Then, we obtain the following theoretical results:

Proposition 1 Female workers' unconditional promotion rate from $j = 1$ to $j = 2$ is lower than male workers'.

Proposition 2 It is possible that female workers' unconditional promotion rate from $j = 2$ to $j = 3$ is higher than male workers'.

Propositions 1 and 2 align with empirical findings in Table 2. Namely, male workers' annual promotion rate from staff member to team leader is significantly higher than the female workers' rate. However, at higher ranks, the promotion rates for male workers are not necessarily higher than those for female workers.[32]

[32]Note that it is also possible that female workers' unconditional promotion rate is lower than male workers' one in Proposition 2. For example, if η_2 is sufficiently large, only male workers who have both low β_i and high θ_i can be promoted to $j = 3$.

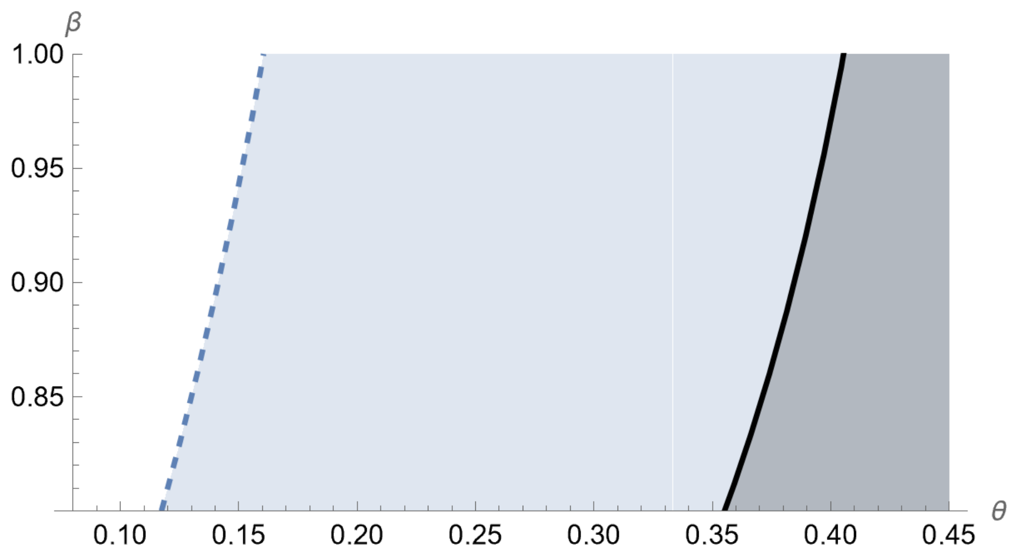


Figure 11: Illustration of Household Behavior

Notes: This figure illustrates the optimal household decisions when $c = 0.3$, $d = 0.05$, $\eta_1 = 1$, and $\eta_2 = 1.5$. In the last period ($t = 3$), the worker's job rank is $j = 1$ if the worker is in the left area of the dashed curve; $j = 2$ if the worker is in the area between the dashed curve and the thick curve, and $j = 3$ if the worker is in the right area of the thick curve.

Proposition 3 It is possible that a female worker who is not promoted to $j = 3$ has higher innate ability (θ_i), human capital $(\eta_{i,3})$, and effective productivity at $j = 3$ $\left(\frac{d_3+c_3\eta_{i,3}}{\beta_i}\right)$ than a male worker who is promoted to $j = 3$.

Proposition 3 highlights a possibility of production and Pareto inefficiency. This result comes from the firm's promotion and evaluation systems. To understand the intuition behind Proposition 3, consider first a female worker with high θ_i and high β_i. Suppose that the female worker does not work long in $t = 1$ and hence does not get promoted to $j = 2$ at the end of $t = 1$. Consider next a male worker with lower θ_i and β_i than the female worker. The male worker may work very long in $t = 1$ so that he can get promoted at the end of both periods. By comparing these two workers, it is possible in $t = 3$ that the female worker has higher innate ability (θ_i), human capital $(\eta_{i,3})$, and effective productivity $\left(\frac{d_3+c_3\eta_{i,3}}{\beta_i}\right)$ than the male worker. As illuminated in the proof, this result is especially relevant when the path to the first promotion is difficult compared to higher promotions. By Figure 7, our data seem to correspond with such a case.

Building on but beyond the discussions on the literature, Proposition 3 theoretically highlights that the job-assignment inefficiency can occur by the combination of the firm's step-by-step promotion policy and evaluating long working hours only at entry-level jobs. That is, even under full information and no taste-based or other a priori gender bias, a firm's seemingly gender-neutral HR management policies themselves can lead to production and Pareto inefficiency, which is disadvantageous to employees who bear childcare responsibilities. Given that such a step-by-step promotion policy is widespread across industries and unrealistic to alter (at least in the firm we empirically investigated), we briefly discuss some possible labor and evaluation reforms in the next section.

6 Concluding Remarks

Using detailed personnel data, we decompose the child penalty into distinct pay components, revealing a substantial child penalty of 55%. The sources of this penalty follow a clear intertemporal pattern: while time-based pay drives the initial impact immediately following childbirth, job-rank-based pay gradually becomes the dominant factor, accounting for the majority of the child penalty by the 15-year mark. This evolution reflects an interconnected mechanism: reduced working hours following childbirth lead to lower performance evaluations, which subsequently constrain promotion opportunities. Our analysis reveals that long working hours serve as a critical factor for advancement within the firm, while our theoretical model demonstrates that such promotion practices can generate production and Pareto inefficiencies.

Our findings highlight that while current promotion practices may appear merit-based in isolation, their gendered implications emerge when considered within the broader social context. In a society where women disproportionately bear caregiving responsibilities, these practices systematically limit advancement opportunities for capable women with children compared to equally qualified men who face fewer time constraints. Our theoretical model demonstrates that these promotion practices can cause production inefficiency. Thus, reconsidering these practices rests on both equity and efficiency grounds: addressing these structural barriers would simultaneously reduce the child penalty while improving firms' talent allocation and productivity.

Our study has some limitations that suggest avenues for future research. Most notably, we do not address why the firm continues to maintain potentially inefficient human resource practices or what prevents changes from being made. We hypothesize that these practices are remnants of a time when the male-sole-breadwinner model was the norm, and the workforce was homogenous, predominantly male, and had ample disposable time due to stay-at-home female partners. In that context, rewarding long working hours did not result in efficiency losses. Additionally, changing internal practices can be costly, and those in higher leadership positions — who advanced under the current system — may have little incentive to push for change. Understanding why firms adopt and maintain certain human resource management practices would provide valuable insights into why the gender gap in the labor market persists and why progress toward closing it is slow.

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Unpacking the Child Penalty Using Personnel Data:
How Promotion Practices Widen the Gender Pay Gap
Appendices

A Data Appendix

A.1 Data Sources

Table 5: Data sources

Data source	period	frequency
Payroll data	September 2013 to January 2024	monthly
Job assignment records	September 2013 to January 2024	monthly
Employee demographics	For all employees in data	
Leave taking records	For all employees in data	
Employee performance evaluation	2014 to 2023	annual
Performance review questionnaire	2016 to 2024	annual

A.2 Summary Statistics

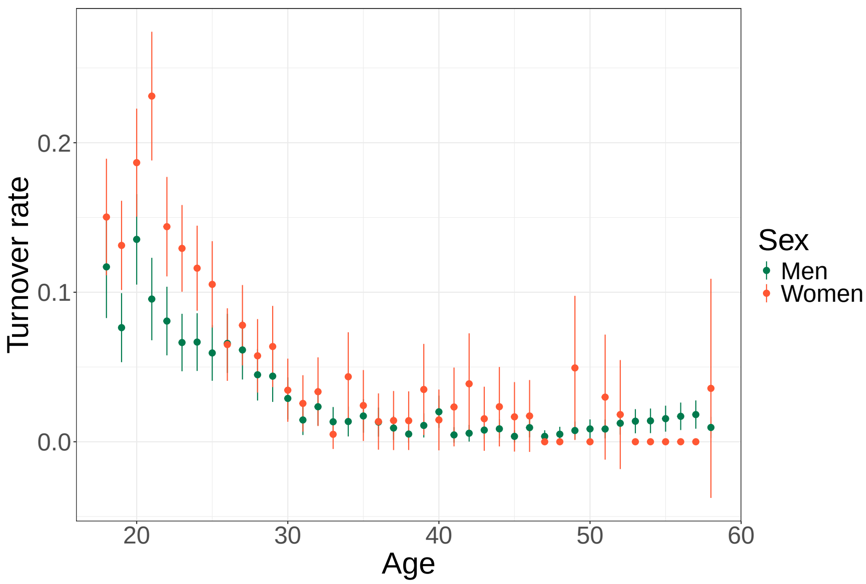
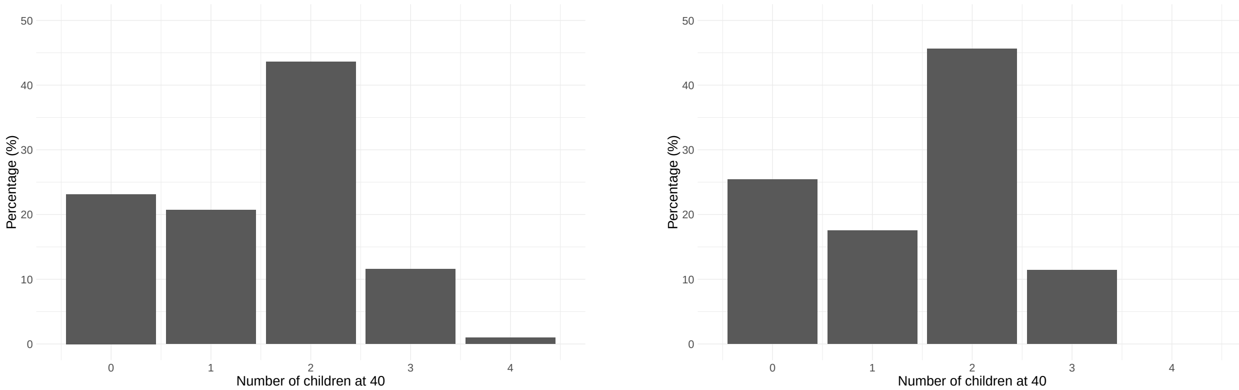


Figure 12: Annual Quit Rate by Age and Gender

Notes: This figure displays the annual share and 95% confidence intervals of employees who quit the firm, calculated separately for age and gender groups, based on internal personnel records from 2013 to 2023.

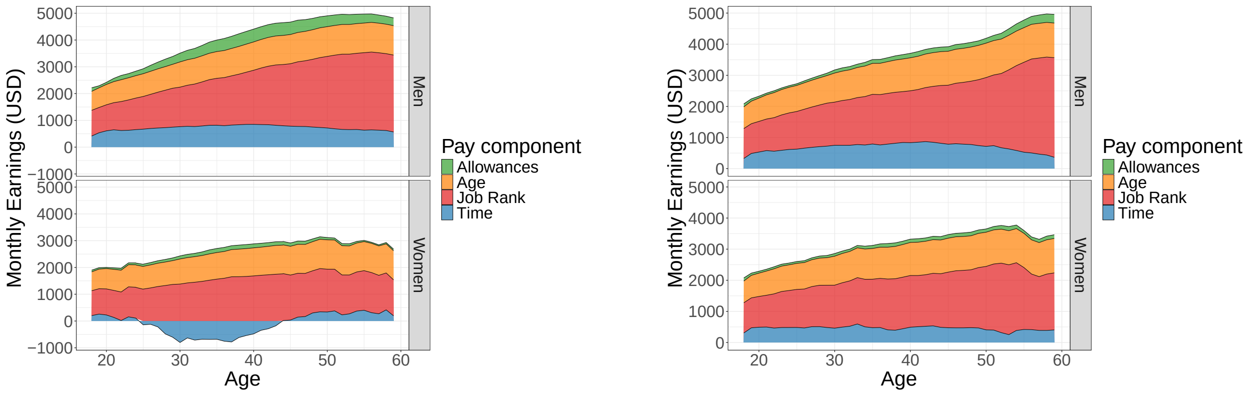
Figure 12 shows the average annual quit rate by age and gender, calculated as the total number of voluntary quits in a given year divided by the number of employees of the corresponding age and gender at the start of the year. The overall average quit rate across all ages is approximately 4%, with the rate decreasing as employees age. Women's quit rates are slightly higher than men's until the age of 25. However, after 25, there is no statistically significant difference in quit rates between men and women.



(a) Men (b) Women

Figure 13: The percentage distribution of the number of children fathered (on the left) or mothered (on the right) by the employees at the age of 40. The sample is limited to employees born in 1983 or earlier who are currently employed at the firm as of September 2022.

Figure 13 displays the percentage distribution of the number of children fathered (left) and mothered (right) by age 40. For both men and women, nearly 45% have two children, while approximately 25% have none.

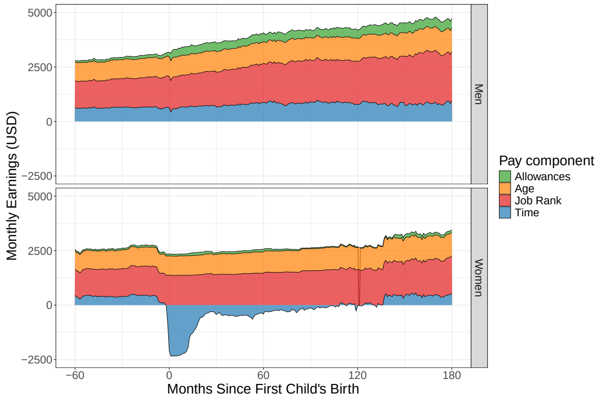


(a) With Children

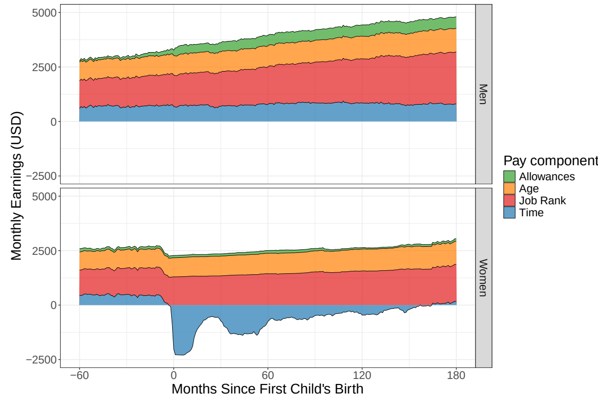
(b) Without Children

Figure 14: Decomposition of Average Monthly Earnings

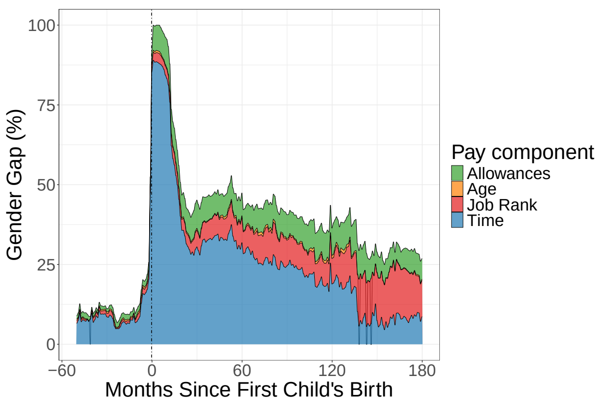
Notes: This figure presents the average monthly earnings by age, gender, and family status groups, broken down into four pay components. Figure 14a displays the one for workers with children while Figure 14b displays the one for those without children. In both figures, the sample is restricted to employees aged 59 or below who have worked for at least one year at domestic office and have had the first child between September 2013 and January 2024. All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY.



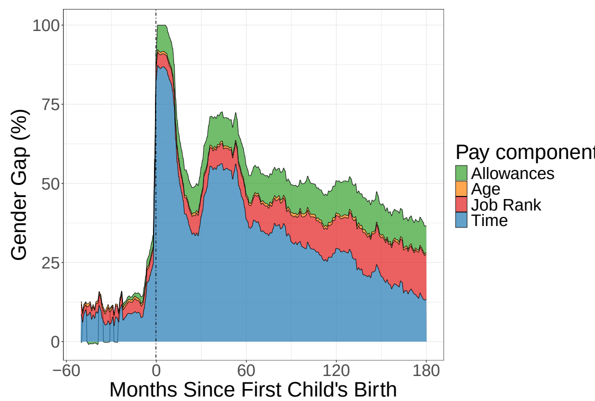
(a) One child



(b) Two or more children



(c) One child

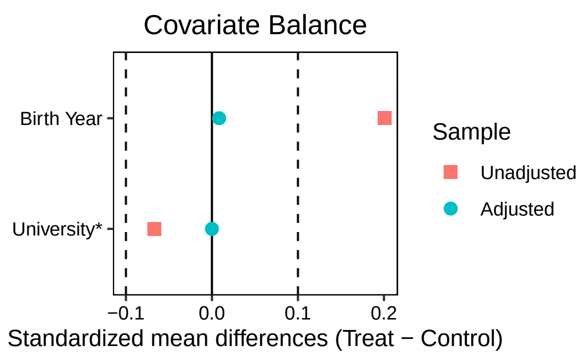


(d) Two or more children

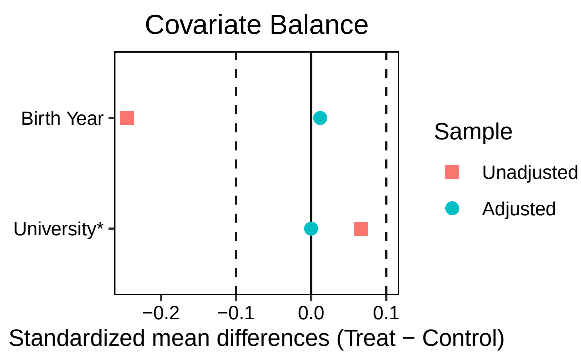
Figure 15: Monthly Earnings Around the Time of the First Childbirth by No. of Children

Notes: Figure 15a and Figure 15b display the accounting decomposition of average monthly earnings 60 months before and 180 months after the first childbirth, by the number of children. Figure 15c and Figure 15d display the earnings difference between male and female employees, by the number of children. The sample is restricted to employees aged 59 or below who have worked for at least one year at domestic office and have had the first child between September 2013 and January 2024. All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY, which was the average exchange rate in September 2013.

A.3 Matching Results



(a) Men



(b) Women

Figure 16: Covariate Balance

Notes: This figure illustrates the covariate balance achieved through coarsened exact matching based on birth year and education level (holding a four-year university degree or not) for men and women. For the continuous variable (birth year), standardized mean differences are shown. For the categorical variable (university degree), row mean differences are displayed, indicated by an asterisk next to the variable name.

Table 6: Balance of Pre-Event Characteristics

	Men			*Women*		
	Treated	Matched Control	Gap	Treated	Matched Control	Gap
Monthly Hours Worked(A year prior to the event)	191	187.52	3.48	173.53	175.23	-1.7
			(0.25)			(0.691)
Performance Evaluation (A year prior to the event)	3.8	3.61	0.19	3.71	3.67	0.04
			(0.007)			(0.596)
Monthly Earnings (t = -12)	3115.39	3030.5	84.89	2699.66	2639.04	60.62
			(0.247)			(0.346)

Notes: This table presents the mean pre-event characteristics: monthly hours worked, performance evaluations, and monthly earnings, all measured one year before (placebo) birth. Columns 1 and 2 compare treated men and their matched controls, while Columns 4 and 5 compare treated women and their matched controls. Columns 3 and 6 shows the difference in means, with p-values in parentheses.

Figure 16 shows the covariate balance achieved through coarsened exact matching on birth year and education level (holding a four-year university degree or not) for men and women. Birth year is coarsely matched in five-year bins. Marital status is also exactly matched, as all treated workers are married, and control workers are drawn from those who have ever married during the study period.

Table 6 reports the balance of pre-event characteristics not used in the matching procedure: monthly hours worked, performance evaluations, and monthly earnings, all measured one year before (placebo) birth. Columns 1 and 2 compare treated men and their matched controls, while Columns 4 and 5 compare treated women and their matched controls. In both cases, the differences are statistically indistinguishable from zero, except for men's performance evaluation scores.

Table 7: Event Study Estimates Under Different Event Study Designs

		Matched Control	Future Parents as Control
Men	Total Earnings	327.40	334.60
	Time-Based Pay Component	23.00	22.00
	Job-Rank-Based Pay Component	60.70	48.10
	Allowances	243.70	264.50
Women	Total Earnings	-1390.00	-1317.10
	Time-Based Pay Component	-1266.60	-1219.60
	Job-Rank-Based Pay Component	-91.60	-54.10
	Allowances	-31.80	-43.50
Child Penalty		55.40	54.20

Notes: This table presents a comparison of event study estimates on the impact of childbirth on monthly earnings by pay component, based on two different event-study designs. Column 1 reports estimates from the regression specified in equation (1), using matched controls. Column 2 reports estimates from the regression specified in equation (6), using future parents as controls. The reported estimates are averaged over the 10 years following childbirth. The reference month is set at the time of conception (e = 10). All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY.

This balance suggests that treated workers followed observably similar career trajectories as their matched controls until having their first child, mitigating concerns about selection into fertility.

Using Future Parents as Control Earlier studies on the child penalty, such as Kleven et al. (2019b), use an event study design where the control group consists of not-yet-treated workers (i.e., future parents) rather than matched controls. To assess the robustness of our main findings to the choice of control group, we conduct an alternative event study using future parents as controls. Specifically, we estimate the following regressions on workers who had their first child during the study period:

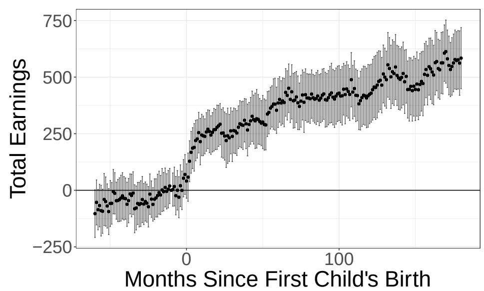
$$Y_{it}^{g} = \sum_{e \neq -10} \alpha_{e}^{g} D_{it}^{e} + \sum_{s} \sum_{k} \beta_{k,s}^{g} Age_{it}^{k} Educ_{i}^{s} + \delta_{t}^{g} + \epsilon_{it}^{g} \tag{6}$$

where Y_{it}^{g} is monthly earnings. $D_{it}^{e} = 1_{[t-E_i=e]}$ are event time dummies for treated unites. The coefficients α_{e}^{g} capture the dynamic effects of the birth of the first child (i.e., the child penalty). We have interactions of age dummies, $Age_{it}^{k} = 1_{[k=age_{it}]}$, and education dummies, $Educ_{i}^{s} = 1_{[s=Educ_i]}$. Folloring Kleven et al. (2019b), we do not include individual fixed effects. Following Adams-Prassl et al. (2024c)'s recommendation, we allow for different age-earnings profiles by education and gender but, unlike theirs, we do not include time-since-graduation due to the high degree of collinearity between age and time-since-graduation. δ_{t}^{g} is gender-specific calendar time fixed effects. The study window spans from 60 months (5 years) before childbirth (or placebo childbirth) to 180 months (15 years) after ($e = [60, \ldots, 180]$), with the timing of conception, $e = -10$, serving as the reference month.

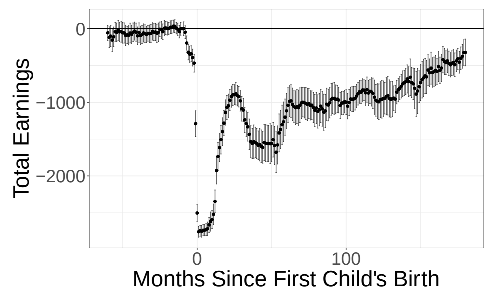
The parameter of interest, α_e^g, represents the impact of childbirth on monthly earnings, relative to ten months before the first childbirth, for individuals who remain with the same firm at event time e. A key assumption for the causal interpretation of α_e^g is a parallel trend assumption: this means that, had they not had children, the trajectory of monthly earnings for employees with children would have been parallel to that of employees without children.

Figure 17 presents event study estimates for each month before and after the birth of the first child, based on equation (6). Table 7 compares event study estimates of earnings components and child penalty effects using matched controls versus future parents as controls. Overall, the estimates from the two event study designs are comparable, suggesting that our findings are not driven by the specific choice of event-study design.

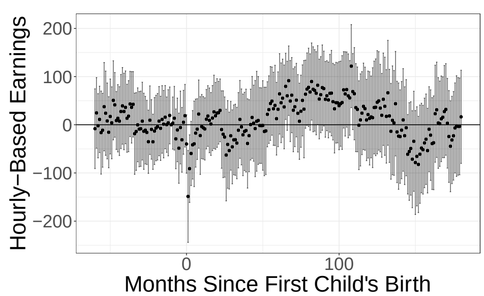
(a) Men – Total



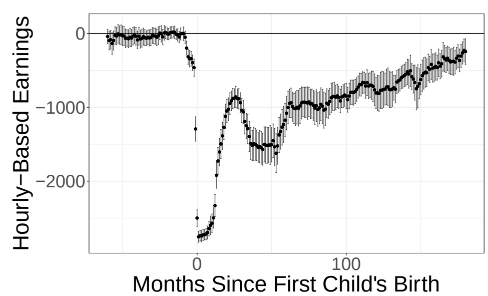
(b) Women – Total



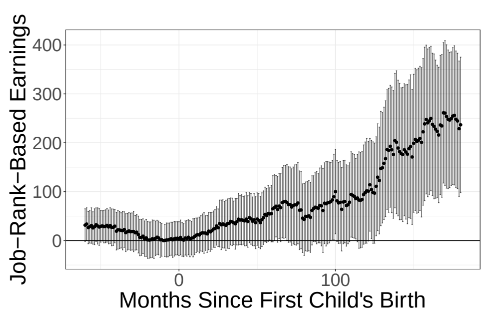
(c) Men – Time-Based Pay Component



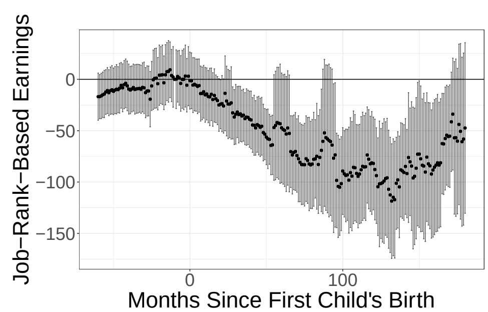
(d) Women – Time-Based Pay Component



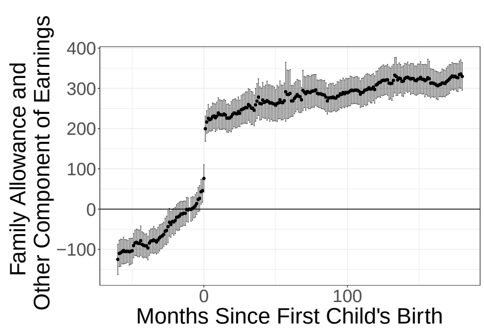
(e) Men – Job-Rank-Based Pay Component



(f) Women – Job-Rank-Based Pay Component



(g) Men – Allowances



(h) Women – Allowances

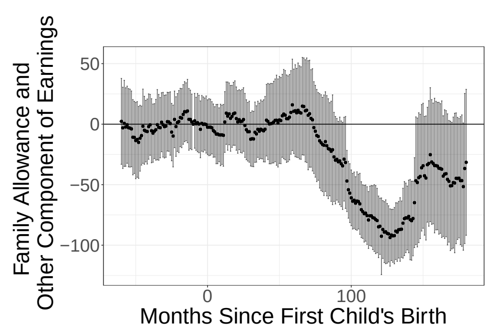
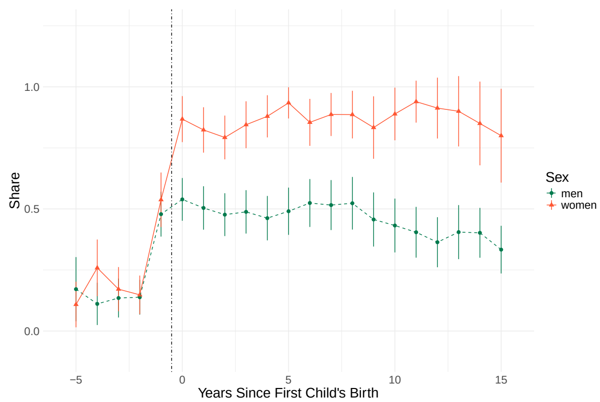


Figure 17: Event Study Estimates Using Future Parents as Control

Notes: This figure shows the event study estimates and 95% confidence intervals for the impact of childbirth on monthly earnings by pay component, based on the regression specified in equation (6). The reference month is set at the time of conception (e = 10). All amounts in Japanese yen are converted to U.S. dollars using an exchange rate of 1 USD = 99 JPY. [19]

A.4 Promotion Aspirations and Work-Family Conflicts



(a) Work-Family Conflicts

(b) Aspiration for promotion

Figure 18: Employee Survey Responses Around the Time of Childbirth

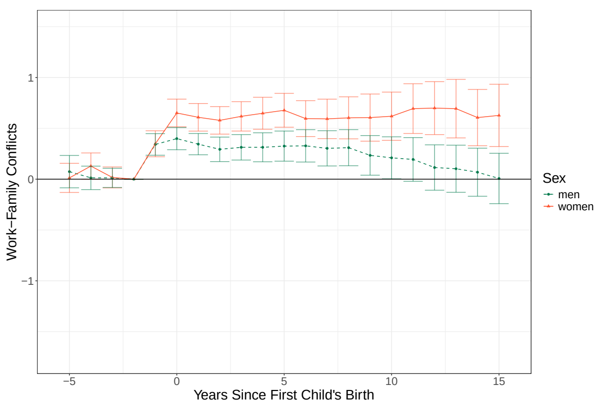
Notes: Figure 18a shows the share and 95% confidential intervals of employees who expressed needs for work accommodations due to family care responsibilities before and after the birth of the first child. Figure 18b shows the share and 95% confidential intervals of employees who expressed their aspiration for promotion before and after the birth of the first child.

In addition to the impacts on monthly earnings presented in Section 3, we also examine the effects of first childbirth on promotion aspirations and work-family conflicts using data from the annual internal employee survey. As described in Section 2, the firm conducts a brief survey during the annual review meeting between supervisors and subordinates, collecting information on employees' work and personal situations for personnel planning purposes. In this analysis, we focus on two key areas: *work-family conflicts* and *promotion aspirations*. Work-family conflicts refer to whether an employee is experiencing personal challenges related to family care and has expressed needs for work accommodations. Promotion aspirations indicate whether an employee seeks advancement to the next rank.

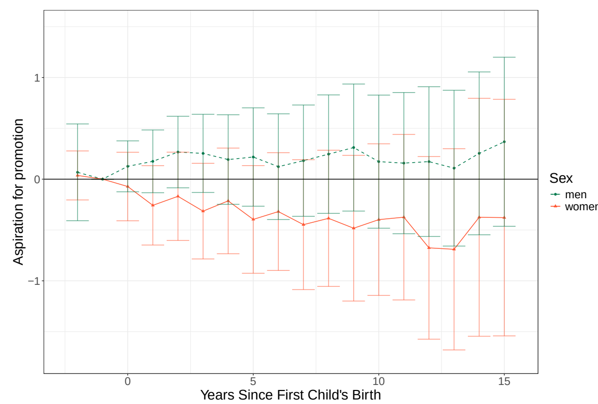
The impact of childbirth on work-family conflict is sharp and immediate. Figure 19a shows the event study estimates on the share of male and female employees reporting work-family conflict in annual surveys. We observe no pre-trend and, as shown in Figure 18, no gender gap in responses prior to childbirth. However, a significant disparity emerges immediately after childbirth, with mothers experiencing a 70-percentage-point increase -- more than double the rate observed for new fathers. This substantial mother-father gap persists and continues to widen over time.

This diverging pattern of work-family conflicts aligns with the leave-taking and hours worked of mothers and fathers. While 93.2% of women take parental leave with an average duration of 366 days, only 4.4% of men do so following the birth of their first child, with an average leave duration of just 29 days (conditional on uptake). Moreover, as discussed in Section 3.2, 78.1% of women opt for reduced work hours, compared to only 0.4% of men. The gender gap is striking but not surprising given the broader context. As discussed in Section 2, women spend about five times more time on household duties than men, the largest gender gap among OECD countries.

Meanwhile, the impact on promotion aspirations do not present a clear picture. Figure 18b displays the share and 95% confidential intervals of employees who expressed their aspiration for promotion before and after the birth of the first child. The data shows that a statistically significant gender gap in promotion aspirations already exists before birth. This pattern aligns with previous research (e.g., Azmat et al., 2024; Hospido et al., 2022), which highlights the gender gap in aspirations as a potential factor in the promotion gap. Post-birth, however, both men's and women's aspirations trend downward without a sharp decline immediately following childbirth. Figure 19b shows the event study estimates of the first childbirth on the percentage of employees who expressed a desire for promotion in annual surveys. The point estimates show a gradual decline for women and a gradual increase for men although none are statistically significant. Thus we cannot conclusively say that aspirations are the primary mechanism behind the diverging outcomes between fathers and mothers, especially compared to the stark effects of work-family conflicts. Our findings do not completely contradict the idea that aspirations are not fixed and may be shaped by earlier experiences either, potentially amplifying the gender gap in career progression (e.g., Azmat et al., 2024).



(a) Work-Family Conflicts



(b) Aspiration for promotion

Figure 19: Impact of First Childbirth on Employee Survey Responses

Notes: This figure shows the event study estimates and 95% confidence intervals for the impact of childbirth on annual employee survey questions, based on the regression specified in equation (1). The reference year is set two years prior to the year of childbirth. In Figure 19a, the outcome is the share of employees who expressed needs for work accommodations due to family care responsibilities before and after the birth of the first child. In Figure 19b, the outcome is the share of employees who expressed their aspiration for promotion before and after the birth of the first child. The row means of the respective outcomes for the treated units are shown in Appendix A.3 Figure 18.

A.5 Determinants of Promotion by Division

Table 8: Determinants of Promotions: Manufacturing Division

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	−0.04	−0.04	−0.00	−0.00	0.29	0.29
	(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.03)
Evaluation score (ref. 3)						
5	0.27	0.27	0.28	0.28	0.29	0.29
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
4	0.04	0.04	0.06	0.06	0.06	0.06
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
2	−0.00	−0.00	−0.01	−0.01	−0.02	−0.02
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
1	−0.00	−0.00				
	(0.00)	(0.00)				
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**						
≥ 50 hours	−0.00	−0.00	0.00	0.00	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
< 40 hours	−0.00	−0.00	−0.00	−0.03	−0.11	−0.10
	(0.00)	(0.00)	(0.04)	(0.03)	(0.03)	(0.03)
Top		0.01		−0.00		−0.00
		(0.01)		(0.01)		(0.01)
Education (ref. High school)						
4-Yr College	0.01	0.01	0.04	0.03	0.00	0.00
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Some College	−0.01	−0.01	0.09	0.09	0.10	0.19
	(0.01)	(0.01)	(0.08)	(0.08)	(0.07)	(0.07)
Mid Carrer	−0.01	−0.01	−0.02	−0.02	−0.05	−0.05
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Age	0.01	0.01	0.04	0.04	0.08	0.08
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	0.03	0.03	0.07	0.07	0.05	0.05
Num.Obs.	13 254	13 249	3059	3021	1596	1576
R2 Adj.	0.115	0.116	0.110	0.111	0.106	0.110
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Period	X	X	X	X	X	X

Notes: This table presents the results from regressing promotion incidence on worker characteristics, as specified in regression equation (4). The sample is restricted to workers in the manufacturing division. Column 1 reports results for all staff members, Column 2 focuses on team leaders, and Column 3 on senior team leaders. Each specification includes division and year fixed effects. Standard errors are clustered at the worker level and are reported in parentheses.

Table 9: Determinants of Promotions: Sales Division

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	−0.08	−0.07	−0.08	−0.13	−0.05	−0.08
	(0.01)	(0.02)	(0.04)	(0.03)	(0.07)	(0.04)
Evaluation score (ref. 3)						
5	0.36	0.34	0.37	0.36	0.28	0.36
	(0.04)	(0.05)	(0.05)	(0.07)	(0.05)	(0.07)
4	0.06	0.06	0.11	0.16	0.08	0.06
	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
2	−0.02	−0.01	−0.00	0.07	−0.05	−0.03
	(0.02)	(0.02)	(0.05)	(0.10)	(0.03)	(0.03)
1	0.01	0.02				
	(0.02)	(0.02)				
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**						
≥ 50 hours	0.06	0.05	−0.05	−0.05	−0.10	−0.10
	(0.16)	(0.16)	(0.04)	(0.04)	(0.04)	(0.06)
< 40 hours	−0.03	−0.03	0.17	0.37	0.07	0.02
	(0.02)	(0.02)	(0.09)	(0.11)	(0.10)	(0.08)
Top		0.02		0.04		−0.00
		(0.01)		(0.03)		(0.03)
Education (ref. High school)						
4-Yr College	0.04	0.04	0.04	−0.00	0.05	0.07
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
Some College	−0.01	−0.01	0.08	0.07	−0.03	0.03
	(0.04)	(0.04)	(0.03)	(0.06)	(0.05)	(0.04)
Mid Carrer	0.04	0.04	0.02	−0.02	−0.01	−0.07
	(0.02)	(0.02)	(0.05)	(0.07)	(0.05)	(0.03)
Age	0.06	0.06	0.05	0.05	0.12	0.13
	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)	(0.03)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	0.09	0.08	0.12	0.12	0.10	0.08
Num.Obs.	1631	1447	853	442	664	464
R2 Adj.	0.176	0.158	0.120	0.120	0.080	0.151
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Period	X	X	X	X	X	X

Notes: This table presents the results from regressing promotion incidence on worker characteristics, as specified in regression equation (4). The sample is restricted to workers in the sales division. Column 1 reports results for all staff members, Column 2 focuses on team leaders, and Column 3 on senior team leaders. Each specification includes division and year fixed effects. Standard errors are clustered at the worker level and are reported in parentheses.

Table 10: Determinants of Promotions: Back Office

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	−0.04	−0.03	0.05	−0.27	−0.03	−0.03
	(0.01)	(0.01)	(0.12)	(0.26)	(0.02)	(0.02)
Evaluation score (ref. 3)						
5	0.16	0.16	0.31	0.87	0.24	0.20
	(0.02)	(0.02)	(0.15)	(0.16)	(0.03)	(0.03)
4	0.02	0.02	0.16	0.32	0.06	0.04
	(0.01)	(0.01)	(0.08)	(0.16)	(0.01)	(0.01)
2	−0.01	−0.01	0.09		0.01	0.01
	(0.01)	(0.01)	(0.15)		(0.03)	(0.04)
1	0.09	0.09				
	(0.03)	(0.03)				
Weekly Hours Worked (ref. $40 \leq$ hours < 50)						
≥ 50 hours	−0.07	−0.08	0.09		0.03	0.02
	(0.01)	(0.01)	(0.11)		(0.03)	(0.03)
< 40 hours	−0.03	−0.02	−0.19	−0.73	0.05	0.04
	(0.01)	(0.01)	(0.09)	(0.20)	(0.02)	(0.03)
Top		0.01		−0.23		0.02
		(0.01)		(0.10)		(0.01)
Education (ref. High school)						
4-Yr College	0.00	0.00	0.13	−0.07	0.03	0.03
	(0.01)	(0.01)	(0.10)	(0.19)	(0.01)	(0.02)
Some College	0.01	−0.00	0.22		0.05	0.02
	(0.01)	(0.01)	(0.08)		(0.03)	(0.03)
Mid Carrer	−0.02	−0.02	0.05	0.16	−0.03	−0.04
	(0.01)	(0.01)	(0.11)	(0.20)	(0.02)	(0.02)
Age	0.03	0.03	0.05	0.12	0.06	0.07
	(0.00)	(0.00)	(0.04)	(0.08)	(0.01)	(0.01)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	0.05	0.05	0.15	0.17	0.06	0.06
Num.Obs.	3464	3123	108	41	1400	1041
R2 Adj.	0.091	0.090	0.052	0.298	0.086	0.077
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Period	X	X	X	X	X	X

Notes: This table presents the results from regressing promotion incidence on worker characteristics, as specified in regression equation (4). The sample is restricted to back office workers. Column 1 reports results for all staff members, Column 2 focuses on team leaders, and Column 3 on senior team leaders. Each specification includes division and year fixed effects. Standard errors are clustered at the worker level and are reported in parentheses.

A.6 Determinants of Evaluation Scores by Division

Table 11: Determinants of Evaluation Scores: Manufacturing Division

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	0.07	0.07	−0.03	−0.03	−0.21	−0.21
	(0.02)	(0.02)	(0.10)	(0.10)	(0.22)	(0.22)
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**						
≥ 50 hours	0.06	0.05	0.03	0.03	−0.04	−0.05
	(0.02)	(0.02)	(0.04)	(0.04)	(0.05)	(0.05)
< 40 hours	−0.20	−0.19	0.13	0.11	0.14	0.13
	(0.03)	(0.03)	(0.09)	(0.10)	(0.18)	(0.19)
Top		0.07		−0.02		0.02
		(0.02)		(0.03)		(0.04)
Education (ref. High school)						
4-Yr College	0.09	0.09	0.11	0.10	0.06	0.06
	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)	(0.06)
Some College	0.16	0.15	−0.14	−0.14	0.41	0.24
	(0.08)	(0.08)	(0.12)	(0.12)	(0.09)	(0.08)
Mid Carrer	0.06	0.06	0.16	0.16	0.15	0.15
	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)
Age	−0.01	−0.01	0.05	0.05	−0.01	−0.01
	(0.01)	(0.01)	(0.02)	(0.02)	(0.05)	(0.05)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	3.28	3.28	3.61	3.62	3.56	3.55
Num.Obs.	13 254	13 249	3059	3021	1596	1576
R2 Adj.	0.141	0.142	0.082	0.082	0.086	0.082
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Period	X	X	X	X	X	X

Notes: This table presents the results from regressing annual evaluation scores on worker characteristics, as specified in regression equation (5). The sample is restricted to workers in the manufacturing division. Column 1 reports results for all staff members, Column 2 focuses on team leaders, and Column 3 on senior team leaders. Each specification includes division and year fixed effects. Standard errors are clustered at the worker level and are reported in parentheses.

Table 12: Determinants of Evaluation Scores: Sales Division

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	-0.11	-0.08	0.00	-0.16	-0.13	-0.19
	(0.05)	(0.05)	(0.07)	(0.07)	(0.14)	(0.13)
Weekly Hours Worked (ref. $40 \leq$ hours < 50)						
≥ 50 hours	0.02	0.02	-0.05	-0.07	0.06	0.14
	(0.20)	(0.20)	(0.10)	(0.08)	(0.12)	(0.14)
< 40 hours	-0.16	-0.16	0.07	0.19	-0.07	0.10
	(0.07)	(0.07)	(0.15)	(0.18)	(0.20)	(0.24)
Top		0.05		0.06		0.00
		(0.04)		(0.06)		(0.06)
Education (ref. High school)						
4-Yr College	-0.00	0.02	0.02	-0.02	0.08	0.08
	(0.06)	(0.06)	(0.07)	(0.08)	(0.08)	(0.09)
Some College	0.21	0.22	0.07	-0.05	-0.54	-0.53
	(0.17)	(0.17)	(0.18)	(0.22)	(0.15)	(0.15)
Mid Carrer	0.07	0.07	0.15	-0.01	-0.25	-0.22
	(0.06)	(0.07)	(0.11)	(0.13)	(0.11)	(0.15)
Age	-0.01	-0.02	0.01	-0.05	0.04	0.02
	(0.02)	(0.02)	(0.04)	(0.06)	(0.08)	(0.09)
Age Squared	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	3.55	3.54	3.68	3.66	3.77	3.72
Num.Obs.	1631	1447	853	442	664	464
R2 Adj.	0.249	0.249	0.154	0.132	0.244	0.264
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Period	X	X	X	X	X	X

Notes: This table presents the results from regressing annual evaluation scores on worker characteristics, as specified in regression equation (5). The sample is restricted to workers in the sales division. Column 1 reports results for all staff members, Column 2 focuses on team leaders, and Column 3 on senior team leaders. Each specification includes division and year fixed effects. Standard errors are clustered at the worker level and are reported in parentheses.

Table 13: Determinants of Evaluation Scores: Back Office

	Staff Member		Team Leader		Senior Team Leader	
	(1)	(2)	(1)	(2)	(1)	(2)
Female	0.05	0.04	0.38	0.52	0.00	−0.03
	(0.04)	(0.04)	(0.23)	(0.16)	(0.07)	(0.07)
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**						
≥ 50 hours	0.20	0.19	−0.58		0.22	0.14
	(0.09)	(0.09)	(0.14)		(0.08)	(0.08)
< 40 hours	−0.20	−0.19	−0.08	0.17	−0.03	−0.08
	(0.03)	(0.04)	(0.22)	(0.13)	(0.06)	(0.06)
Top		0.06		−0.14		0.09
		(0.03)		(0.12)		(0.04)
Education (ref. High school)						
4-Yr College	0.18	0.16	−0.10	−0.07	0.01	0.01
	(0.04)	(0.04)	(0.16)	(0.13)	(0.06)	(0.07)
Some College	0.14	0.13	0.19		0.07	0.11
	(0.09)	(0.09)	(0.16)		(0.13)	(0.13)
Mid Carrer	−0.04	−0.06	−0.32	−0.12	0.05	−0.00
	(0.06)	(0.06)	(0.26)	(0.12)	(0.09)	(0.10)
Age	0.08	0.09	0.09	0.13	0.01	0.06
	(0.01)	(0.01)	(0.08)	(0.08)	(0.05)	(0.06)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	3.68	3.68	3.72	3.73	3.75	3.76
Num.Obs.	3464	3123	108	41	1400	1041
R2 Adj.	0.174	0.175	0.240	0.467	0.151	0.140
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id
FE: Period	X	X	X	X	X	X

Notes: This table presents the results from regressing annual evaluation scores on worker characteristics, as specified in regression equation (5). The sample is restricted to back office workers. Column 1 reports results for all staff members, Column 2 focuses on team leaders, and Column 3 on senior team leaders. Each specification includes division and year fixed effects. Standard errors are clustered at the worker level and are reported in parentheses.

A.7 Additional Analyses on Evaluation and Promotion Dynamics

Table 14: Determinants of Promotions

	Staff Member			Team Leader			Senior Team Leader		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Female	−0.04	−0.04	−0.04	−0.02	−0.02	−0.02	−0.02	−0.02	0.01
	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Evaluation score (ref. 3)									
5	0.24	0.24	0.24	0.29	0.29	0.29	0.26	0.26	0.26
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
4	0.04	0.04	0.04	0.07	0.07	0.07	0.06	0.06	0.06
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
2	−0.01	−0.00	−0.00	−0.01	−0.01	−0.01	−0.02	−0.02	−0.02
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
1	0.00	0.01	0.01						
	(0.01)	(0.01)	(0.01)						
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**									
≥ 50 hours	−0.00	−0.00	−0.00	0.00	0.00	0.00	−0.00	−0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
< 40 hours	−0.01	−0.02	−0.01	0.03	0.02	0.02	0.04	0.04	0.05
	(0.00)	(0.00)	(0.00)	(0.03)	(0.03)	(0.04)	(0.02)	(0.02)	(0.02)
Education (ref. High school)									
4-Yr College	0.00	0.00	0.00	0.04	0.04	0.04	0.02	0.02	0.02
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Some College	0.00	0.00	0.00	0.09	0.09	0.09	0.03	0.03	0.03
	(0.01)	(0.01)	(0.01)	(0.04)	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)
Mid Carrer	−0.01	−0.01	−0.01	−0.02	−0.02	−0.02	−0.04	−0.04	−0.04
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Child		0.02	0.02		0.01	0.01		0.01	0.02
		(0.00)	(0.00)		(0.01)	(0.01)		(0.01)	(0.01)
Female*Child			−0.03			0.02			−0.09
			(0.01)			(0.04)			(0.03)
Age	0.01	0.01	0.01	0.04	0.04	0.04	0.07	0.07	0.07
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	0.04	0.04	0.04	0.08	0.08	0.08	0.07	0.07	0.07
Num.Obs.	18 349	18 349	18 349	4020	4020	4020	3660	3660	3660
R2 Adj.	0.114	0.115	0.116	0.117	0.117	0.117	0.092	0.092	0.094
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id	by: id	by: id	by: id
FE: Division	X	X	X	X	X	X	X	X	X
FE: Period	X	X	X	X	X	X	X	X	X

Notes: This table presents regression results examining promotion incidence based on worker characteristics, as specified in regression equation (4). The regressions include an indicator variable for whether a worker has children and its interaction with a female dummy variable, with and without these controls. The sample comprises workers from all divisions combined. The first three columns show results for all staff members, the next three focus on team leaders, and the final three on senior team leaders. All regressions include division and year fixed effects. Standard errors, clustered at the worker level, are reported in parentheses.

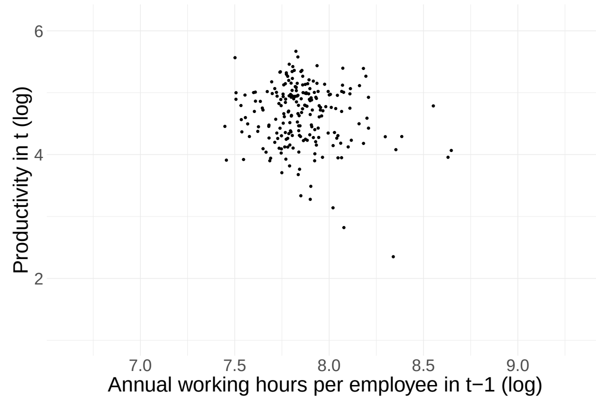
Table 15: Determinants of Evaluation Scores

	Staff Member			Team Leader			Senior Team Leader		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Female	0.05	0.06	0.06	0.02	0.06	0.05	−0.04	0.00	−0.03
	(0.02)	(0.02)	(0.02)	(0.07)	(0.07)	(0.08)	(0.06)	(0.06)	(0.07)
Weekly Hours Worked (ref. $40 \leq$ **hours** < 50**)**									
≥ 50 hours	0.07	0.07	0.07	0.03	0.03	0.03	0.03	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
< 40 hours	−0.20	−0.26	−0.26	0.11	0.08	0.08	0.00	−0.02	−0.03
	(0.02)	(0.02)	(0.02)	(0.08)	(0.08)	(0.08)	(0.05)	(0.05)	(0.05)
Education (ref. High school)									
4-Yr College	0.13	0.13	0.13	0.09	0.10	0.10	0.05	0.05	0.05
	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Some College	0.16	0.15	0.15	0.01	−0.02	−0.02	0.04	0.05	0.06
	(0.06)	(0.06)	(0.06)	(0.12)	(0.12)	(0.12)	(0.10)	(0.10)	(0.10)
Mid Carrer	0.04	0.04	0.04	0.15	0.14	0.14	0.10	0.09	0.09
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)
Child		0.20	0.20		0.11	0.11		0.12	0.11
		(0.02)	(0.02)		(0.03)	(0.03)		(0.03)	(0.03)
Female*Child			0.00			0.03			0.09
			(0.04)			(0.13)			(0.11)
Age	−0.00	−0.01	−0.01	0.05	0.04	0.04	0.01	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Age Squared	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Outcome	3.38	3.38	3.38	3.63	3.63	3.63	3.67	3.67	3.67
Num.Obs.	18 349	18 349	18 349	4020	4020	4020	3660	3660	3660
R2 Adj.	0.201	0.215	0.215	0.097	0.104	0.103	0.146	0.153	0.154
Std.Errors	by: id	by: id	by: id	by: id	by: id	by: id	by: id	by: id	by: id
FE: Division	X	X	X	X	X	X	X	X	X
FE: Period	X	X	X	X	X	X	X	X	X

Notes: This table presents the results of regressions analyzing annual evaluation scores based on worker characteristics, as specified in regression equation (5). The regressions include an indicator variable for whether a worker has children and its interaction with a female dummy variable, with and without these controls. The sample comprises workers from all divisions combined. The first three columns show results for all staff members, the next three focus on team leaders, and the final three on senior team leaders. All regressions include division and year fixed effects. Standard errors, clustered at the worker level, are reported in parentheses.

A.8 Hours Worked and Productivity

(a) Manufacturing



(b) Sales

Figure 20: Past Hours Worked and Current Productivity

Notes: This figure illustrates the relationship between average annual hours worked in year t and average production output per hour in the following year, by division (manufacturing and sales). Output is measured as gross revenue from non-durable consumer goods for manufacturing teams and gross sales for sales teams. Since output data is available only at the team level, we calculate per-worker measures by dividing team output by the number of non-managerial workers and averaging annual hours worked at the team level.

One key hypothesis for why longer working hours lead to better career outcomes is human capital accumulation - the idea that additional work hours build skills through learning-by-doing (see Shaw, 1989; Imai and Keane, 2004). If this mechanism explains our findings, we would expect employees who work longer hours to become more productive over time, justifying their higher evaluation scores.

To test this hypothesis, we examine team-level data on annual hours worked and production outputs. We measure outputs using gross revenue from non-durable consumer goods for manufacturing teams and gross sales for sales teams. Since output data is only available at the team level, we construct per-worker measures by dividing team outputs by the number of non-managerial workers and averaging annual hours worked at the team level.

Visual evidence provides little support for the human capital accumulation hypothesis. Figure 20 shows no apparent correlation between log average per-worker outputs in year t and log per-worker annual hours worked in year t-1.

Statistical tests confirm this pattern. Table 16 presents regressions of log productivity measures in year t on log annual hours worked in t-1. The coefficient on lagged hours worked is negative in the baseline specification (Column 1) and remains insignificant when we add year and team fixed effects (Column 2), control for current year hours (Column 3), or include all controls (Column 4).

Table 16: Hours Worked and Productivity

Panel a: Manufacturing Division

	(1)	(2)	(3)	(4)
Annual working hours per employee in t1 (log)	−0.43***	0.04	−0.33+	0.05
	(0.11)	(0.06)	(0.17)	(0.06)
Annual working hours per employee in t (log)			−0.14	−0.03
			(0.20)	(0.06)
Mean Outcome	3.05	3.05	3.05	3.05
Num.Obs.	497	497	497	497
R2 Adj.	0.023	0.974	0.022	0.974
Std.Errors	Heteroskedasticity-robust	by: Team	Heteroskedasticity-robust	by: Team
FE: Period		X		X
FE: Team		X		X

Panel b: Sales Division

	(1)	(2)	(3)	(4)
Annual working hours per employee in t1 (log)	−0.36+	−0.52*	−0.21	−0.59**
	(0.21)	(0.19)	(0.30)	(0.18)
Annual working hours per employee in t (log)			−0.27	0.14
			(0.31)	(0.17)
Mean Outcome	4.64	4.64	4.64	4.64
Num.Obs.	217	217	217	217
R2 Adj.	0.014	0.914	0.014	0.914
Std.Errors	Heteroskedasticity-robust	by: Team	Heteroskedasticity-robust	by: Team
FE: Period		X		X
FE: Team		X		X

Notes: This table presents the results of regressions analyzing the relationship between workers' productivity (log productivity) in year t and their annual working hours (log hours) in the previous year (t-1). The top panel presents results for workers in the Manufacturing Division, while the bottom panel focuses on those in the Sales Division. In each panel, Column 1 reports the baseline results. Columns 2 to 4 add more controls: year and team fixed effects (Column 2), controls for current year hours (Column 3), and all controls together (Column 4). Standard errors, clustered at the team level, are shown in parentheses.

This pattern holds for both manufacturing and sales divisions.

Together, these results provide little support for human capital accumulation as the primary mechanism linking working hours to career advancement in our setting.

B Supplementary Analyses Using Representative Sample

To contextualize our study within the broader national labor market, we analyze maternal employment patterns in Japan using the Japan Panel Survey of Consumers (JPSC 1993-2020), which provides the longest-running longitudinal data on a nationally representative sample of women.

B.1 Women's Employment Pattern Around Childbirth in Japan

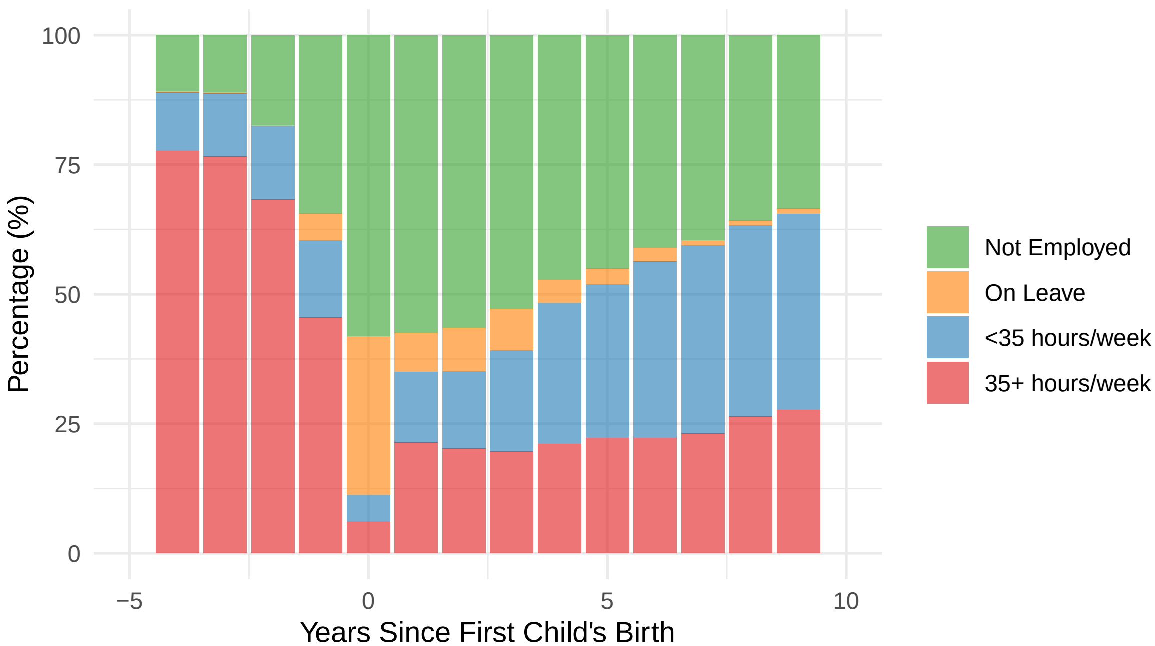


Figure 21: Women's Employment Pattern Around Childbirth

Notes: This figure shows employment outcomes from three years before to ten years after first childbirth for 424 women who gave birth in or after 2000. Employment status is categorized as: not employed, on parental leave, part-time (<35 hours/week), or full-time (35+ hours/week).

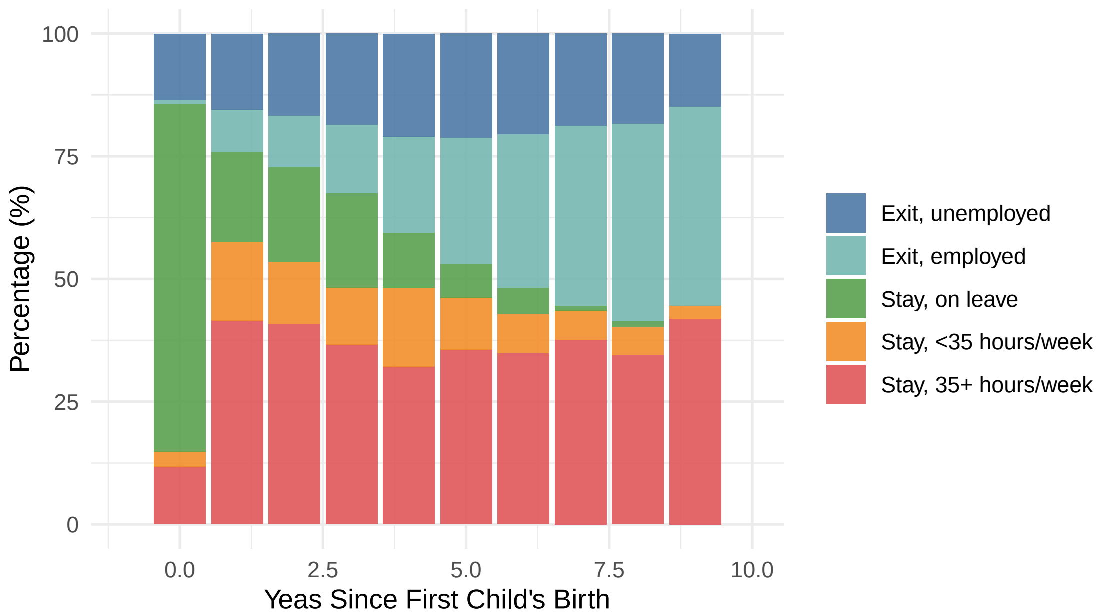
Previous studies have shown that Japan experiences one of the largest child penalties in employment across countries. For instance, Kleven et al. (2023) estimate Japan's child penalty at 0.44, averaged over ten years post-childbirth. Our JPSC analysis confirms this pattern. Figure 21 illustrates the employment status of women from three years before to ten years after the birth of their first child. Employment drops begin two years before childbirth, with unemployment reaching 60% by birth year. Full-time work (35+ hours/week) decreases from 75% to 20% after childbirth, indicating significant reductions in both labor force participation and hours worked.

However, these country-level estimates mask important heterogeneities in maternal employment, particularly across firm characteristics. A crucial factor, relevant to our study, is whether firms have formalized parental leave policies. As described in Section 2, Japanese law guarantees workers parental leave until their child turns one, with three specific exceptions requiring union agreement: workers with less than one year tenure, contracts expiring within a year, or schedules under two days weekly. While violations can result in fines or public censure, implementation varies significantly across firms. Since the 1992 national mandate, many firms have formalized leave policies — some, like our study firm, exceeding legal requirements. Yet at firms without formal policies, workers often hesitate to request leave, fearing retaliation or career penalties.

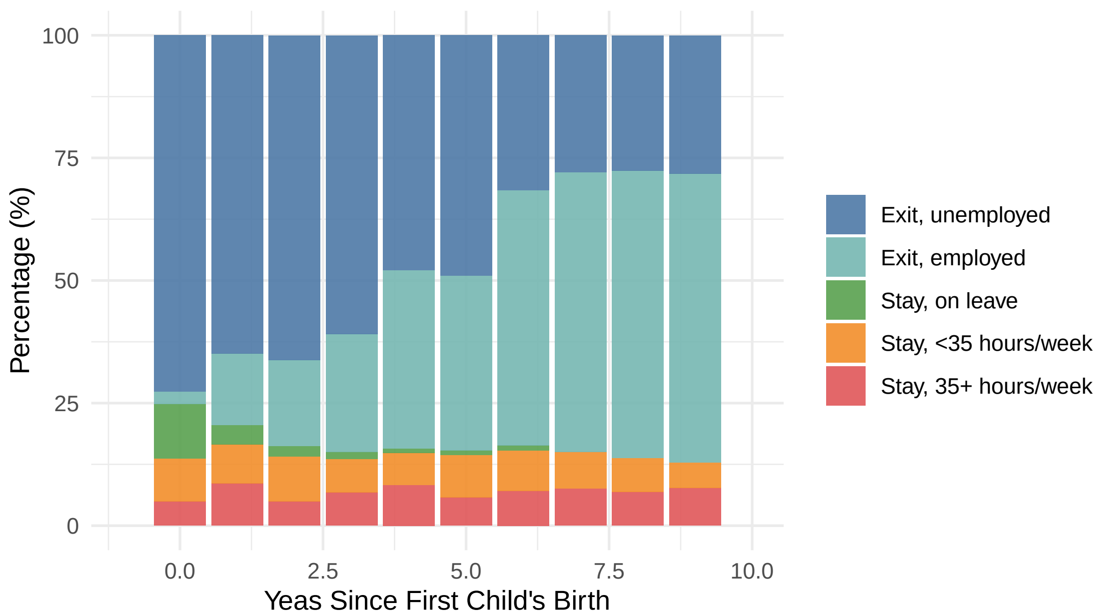
Our JPSC analysis indicates that the availability of a firm's formal parental leave (PL) policy correlates with worker job transitions. Conditional on being employed a year prior to their first childbirth, Figures 22a and 22b track employment outcomes up to 10 years post-birth for workers employed one year before childbirth, segmented by their firm's formal PL policy status. We categorize outcomes as: full-time at pre-birth firm (35+ hours/week), part-time at pre-birth firm, on leave, employed elsewhere, or unemployed. PL policy availability is self-reported, and therefore includes cases where employees may not know if their pre-birth firm has a formal policy.

The upper panel 22b displays the employment outcomes of those whose pre-birth firm had a PL policy. The majority of 75% of this group *remain* with the pre-birth firm, often taking leave. This group exhibits a high level of employment attachment; even when their children are young, the employment rate stays around 75% and rises to over 80% by the ten-year mark. In contrast, the lower panel 22b shows the employment outcomes of those whose pre-birth firm did not have a parental leave (PL) policy. In the year of childbirth, about 75% of these workers *quit* the pre-birth firm, with only 25% remaining. Among those who stayed, half were still unemployed five years after childbirth. By the ten-year mark, the employment rate in this group recovers to around 70%.

These heterogeneous patterns reflect both pre-birth sorting into firms, as well as the causal impact of formalizing parental leave (PL) as part of a firm's workplace policies. Women employed at firms offering formal PL policies show a stronger tendency to remain with the same firm, making the analysis of within-firm child penalties for these women particularly relevant for understanding broader labor market child penalties and their connection to promotion practices.



(a) Firm PL available



(b) Firm PL not available

Figure 22: Post Birth Cumulative Job Transition by PL availability

Notes: This figure tracks cumulative job transitions up to 10 years after first childbirth, based on the availability of formal parental leave (PL) policies at pre-birth firms. The sample includes women employed with positive hours one year pre-birth. We categorize outcomes as: full-time work at pre-birth firm (35+ hours/week), part-time work at pre-birth firm (<35 hours/week), on leave, employment at another firm, or unemployment. Figure 22a shows outcomes for women whose pre-birth firms had formal PL policies (54% of pre-birth employed sample). Figure 22b shows outcomes for women whose firms either lacked formal PL policies or whose policy status was unknown (38% of sample). The remaining 8% did not respond to the PL policy question.

C Proofs of Propositions

We first characterize the the worker's optimal decision in our model of promotion. Note that

$$\begin{aligned}U(\theta_i,\beta_i)=&[d_1+c_1\theta_i]h_{i,1}-\frac{1}{2}\beta_i h_{i,1}^2\\&+[d_j+c_j(2\theta_i+h_{i,1})]h_{i,2}-\frac{1}{2}\beta_i h_{i,2}^2\\&+[d_j+c_j(3\theta_i+h_{i,1}+\mathbf{1}_{j(2)=1}h_{i,2})]h_{i,3}-\frac{1}{2}\beta_i h_{i,3}^2.\end{aligned}$$

By solving out this maximization problem, we obtain the following three cases:

(i) Worker i is never promoted, i.e., $j(1)=j(2)=j(3)=1$. In this case,

$$\begin{aligned}h_{i,1}^{np}&=\frac{1}{\beta_i+c_1}\left(d_1+c_1\theta_i+c_1\frac{3d_1+6c_1\theta_i}{\beta_i-2c_1}\right),\\h_{i,2}^{np}&=\frac{1}{\beta_i+c_1}\left(d_1+2c_1\theta_i+c_1\frac{3d_1+6c_1\theta_i}{\beta_i-2c_1}\right),\\h_{i,3}^{np}&=\frac{1}{\beta_i+c_1}\left(d_1+3c_1\theta_i+c_1\frac{3d_1+6c_1\theta_i}{\beta_i-2c_1}\right),\end{aligned}$$

where $h_{i,1}^{np}+h_{i,2}^{np}<\eta_1-3\theta_i$. Let $U^{np}(\theta_i,\beta_i)$ denote the indirect utility of worker i in this case.

(ii) Worker i is promoted to $j=2$ at the end of period 2, i.e., $j(1)=j(2)=1$ and $j(3)=2$. In this case, if i works more than the promotion cutoff (i.e., $h_{i,1}+h_{i,2}>\eta_1-3\theta_i$), then

$$\begin{aligned}h_{i,1}^{sp1}&=\frac{c_1[\beta_i\left(\beta_i\theta_i+d_1\right)+c_2d_2+4c_2^2\theta_i]+\beta_i\left(\beta_i d_1+c_2d_2+3c_2^2\theta_i\right)+2\beta_i c_1^2\theta_i}{(\beta_i+c_1)[(\beta_i-c_1)\beta_i-2c_2^2]},\\h_{i,2}^{sp1}&=\frac{c_1[\beta_i\left(2\beta_i\theta_i+d_1\right)+c_2d_2+2c_2^2\theta_i]+\beta_i\left(\beta_i d_1+c_2d_2+3c_2^2\theta_i\right)+\beta_i c_1^2\theta_i}{(\beta_i+c_1)[(\beta_i-c_1)\beta_i-2c_2^2]},\\h_{i,3}^{sp1}&=\frac{(\beta_i-c_1)d_2+c_2(2d_1+3\beta_i\theta_i)}{(\beta_i-c_1)\beta_i-2c_2^2}.\end{aligned}$$

where $h_{i,1}^{sp1}<\eta_1-2\theta_i$. Let $U^{sp1}(\theta_i,\beta_i)$ denote the indirect utility of worker i in this case.

If i works just enough to be promoted (i.e., $h_{i,1}+h_{i,2}=\eta_1-3\theta_i$), then

$$h_{i,1}^{sp2}=\frac{\eta_1}{2}-\frac{4c_1+3\beta_i}{2c_1+2\beta_i}\theta_i,\quad h_{i,2}^{sp2}=\frac{\eta_1}{2}-\frac{2c_1+3\beta_i}{2c_1+2\beta_i}\theta_i,\quad h_{i,3}^{sp2}=\frac{d_2+c_2\eta_1}{\beta_i}.$$

Let $U^{sp2}(\theta_i,\beta_i)$ denote the indirect utility of worker i in this case.

(iii) Worker i is promoted to $j = 2$ at the end of period 1 but not promoted at the end of period 2, i.e., $j(1) = 1$ and $j(2) = j(3) = 2$. In this case, if i works more than the promotion cutoff (i.e., $h_{i,1} > \eta_1 - 2\theta_i$), then

$$\begin{aligned}
h_{i,1}^{fp1} &= \frac{c_1\beta_i\theta_i + \beta_i d_1 + 2c_2 d_2 + 5c_2^2\theta_i}{\beta_i^2 - 2c_2^2}, \\
h_{i,2}^{fp1} &= \frac{\beta_i^2 d_2 + \beta_i c_2\left(2\beta_i\theta_i + c_1\theta_i + d_1\right) + c_2^3\theta_i}{\beta_i^3 - 2\beta_i c_2^2}, \\
h_{i,3}^{fp1} &= \frac{\beta_i^2 d_2 + \beta_i c_2\left(3\beta_i\theta_i + c_1\theta_i + d_1\right) - c_2^3\theta_i}{\beta_i^3 - 2\beta_i c_2^2},
\end{aligned}$$

where $h_{i,1}^{fp1} < \eta_2 - 3\theta_i$. Let $U^{fp1}(\theta_i, \beta_i)$ denote the indirect utility of worker i in this case.

If i works just enough to be promoted to $j = 2$ at the end of $t = 1$ (i.e., $h_{i,1} = \eta_1 - 2\theta_i$), then

$$h_{i,1}^{fp2} = \eta_1 - 2\theta_i, \quad h_{i,2}^{fp2} = \frac{d_2 + c_2\eta_1}{\beta_i}, \quad h_{i,3}^{fp2} = \frac{d_2 + c_2(\eta_1 + \theta_i)}{\beta_i},$$

where $h_{i,1}^{fp2} < \eta_2 - 3\theta_i$. Let $U^{fp2}(\theta_i, \beta_i)$ denote the indirect utility of worker i in this case.

(iv) Worker i is promoted in both periods, i.e., $j(1) = 1$, $j(2) = 2$, and $j(3) = 3$. In this case, if works more than the promotion cutoff (i.e., $h_{i,1} > \eta_2 - 3\theta_i$), then

$$\begin{aligned}
h_{i,1}^{bp1} &= \frac{c_1\beta_i\theta_i + \beta_i d_1 + c_2 d_2 + c_3 d_3 + 2c_2^2\theta_i + 3c_3^2\theta_i}{\beta_i^2 - c_2^2 - c_3^2}, \\
h_{i,2}^{bp1} &= \frac{d_2\left(\beta_i^2 - c_3^2\right) + c_2[c_1\beta_i\theta_i + \beta_i\left(2\beta_i\theta_i + d_1\right) + c_3 d_3 + c_3^2\theta_i]}{\beta_i\left(\beta_i^2 - c_2^2 - c_3^2\right)}, \\
h_{i,3}^{bp1} &= \frac{d_3\left(\beta_i^2 - c_2^2\right) + c_3[c_1\beta_i\theta_i + \beta_i\left(3\beta_i\theta_i + d_1\right) + c_2 d_2 - c_2^2\theta_i]}{\beta_i\left(\beta_i^2 - c_2^2 - c_3^2\right)},
\end{aligned}$$

where $h_{i,1}^{bp1} > \eta_2 - 3\theta_i$. Let $U^{bp1}(\theta_i, \beta_i)$ denote the indirect utility of worker i in this case.

If i works just enough to be promoted to $j = 3$ and promotion to $j = 3$ is the bottleneck (i.e., $h_{i,1} = \eta_2 - 3\theta_i$ and $\eta_1 + \theta_i \le \eta_2$), then

$$h_{i,1}^{bp2} = \eta_2 - 3\theta_i, \quad h_{i,2}^{bp2} = \frac{d_2 + c_2(\eta_2 - \theta_i)}{\beta_i}, \quad h_{i,3}^{bp2} = \frac{d_3 + c_3\eta_2}{\beta_i}.$$

Let $U^{bp2}(\theta_i, \beta_i)$ denote the indirect utility of worker i in this case.

If i works just enough to be promoted to $j = 3$ and promotion to $j = 2$ is the bottleneck (i.e., $h_{i,1} = \eta_2 - 3\theta_i$ and $\eta_1 + \theta_i > \eta_2$; in this case, worker i always gets promoted to $j = 3$ once he is promoted at the end of $t = 1$), then

$$h_{i,1}^{bp3} = \eta_1 - 2\theta_i, \quad h_{i,2}^{bp3} = \frac{d_2 + c_2\eta_1}{\beta_i}, \quad h_{i,3}^{bp3} = \frac{d_3 + c_3(\eta_1 + \theta_i)}{\beta_i}.$$

Let $U^{bp3}(\theta_i, \beta_i)$ denote the indirect utility of worker i in this case.

C.1 Proof of Proposition 1.

Note that by the envelop theorem, the change of the indirect utility with respect to β_i is:

$$\frac{\partial U^z(\theta_i, \beta_i)}{\partial \beta_i} = -\frac{1}{2}\left[(h_{i,1}^z)^2 + (h_{i,2}^z)^2 + (h_{i,3}^z)^2\right].$$

for $z = np, sp1, fp1, bp1$. Because $h_{i,1}^{np} + h_{i,2}^{np} < \eta_1 - 3\theta_i < h_{i,1}^{sp1} + h_{i,2}^{sp1}$, $\eta_1 - 2\theta_i < h_{i,1}^{fp1} < h_{i,1}^{bp1}$, and $0 < c_1 < c_2 < c_3$, it is straightforward to check that

$$\frac{\partial U^z(\theta_i, \beta_i)}{\partial \beta_i} < \frac{\partial U^{np}(\theta_i, \beta_i)}{\partial \beta_i} < 0,$$

for $z = sp1, fp1, bp1$. Hence, as β_i increases, worker i becomes more likely to prefer np to $fp1$, $sp1$, or $bp1$.

It remains to compare the indirect utility under np with the one under $bp3, bp2, fp2, sp2$. First, we compare the indirect utilities under np and $bp3$. Note that

$$\begin{aligned} U^{bp3}(\theta_i, \beta_i) =& [d_1 + c_1\theta_i](\eta_1 - 2\theta_i) - \frac{1}{2}\beta_i(\eta_1 - 2\theta_i)^2 \\ &+ [d_2 + c_2\eta_1]h_{i,2}^{bp3} - \frac{1}{2}\beta_i(h_{i,2}^{bp3})^2 \\ &+ [d_3 + c_3(\eta_1 + \theta_i)]h_{i,3}^{bp3} - \frac{1}{2}\beta_i(h_{i,3}^{bp3})^2. \end{aligned}$$

By taking the derivative with respect to β_i and re-arrange the terms, we have

$$\frac{\partial U^{bp3}(\theta_i, \beta_i)}{\partial \beta_i} = -\frac{1}{2}\left[(h_{i,1}^{bp3})^2 + (h_{i,2}^{bp3})^2 + (h_{i,3}^{bp3})^2\right].$$

Hence, it is straightforward to check that

$$\frac{\partial U^{bp3}(\theta_i, \beta_i)}{\partial \beta_i} < \frac{\partial U^{np}(\theta_i, \beta_i)}{\partial \beta_i} < 0.$$

Second, we compare the indirect utilities under np and $bp2$. Note that

$$\begin{aligned}U^{bp2}(\theta_i, \beta_i) =& [d_1 + c_1\theta_i](\eta_2 - 3\theta_i) - \frac{1}{2}\beta_i(\eta_2 - 3\theta_i)^2 \\ &+ [d_2 + c_2(\eta_2 - \theta_i)]h_{i,2}^{bp2} - \frac{1}{2}\beta_i(h_{i,2}^{bp2})^2 \\ &+ [d_3 + c_3\eta_3]h_{i,3}^{bp2} - \frac{1}{2}\beta_i(h_{i,3}^{bp2})^2.\end{aligned}$$

By taking the derivative with respect to β_i and re-arrange the terms, we have

$$\frac{\partial U^{bp2}(\theta_i, \beta_i)}{\partial \beta_i} = -\frac{1}{2}\left[(h_{i,1}^{bp2})^2 + (h_{i,2}^{bp2})^2 + (h_{i,3}^{bp2})^2\right].$$

Hence, it is straightforward to check that

$$\frac{\partial U^{bp2}(\theta_i, \beta_i)}{\partial \beta_i} < \frac{\partial U^{np}(\theta_i, \beta_i)}{\partial \beta_i} < 0.$$

Third, we compare the indirect utilities under np and $fp2$. Note that

$$\begin{aligned}U^{fp2}(\theta_i, \beta_i) =& [d_1 + c_1\theta_i](\eta_1 - 2\theta_i) - \frac{1}{2}\beta_i(\eta_1 - 2\theta_i)^2 \\ &+ [d_2 + c_2\eta_1]h_{i,2}^{fp2} - \frac{1}{2}\beta_i(h_{i,2}^{fp2})^2 \\ &+ [d_2 + c_2(\eta_1 + \theta_i)]h_{i,3}^{fp2} - \frac{1}{2}\beta_i(h_{i,3}^{fp2})^2.\end{aligned}$$

By taking the derivative with respect to β_i and re-arrange the terms, we have

$$\frac{\partial U^{fp2}(\theta_i, \beta_i)}{\partial \beta_i} = -\frac{1}{2}\left[(h_{i,1}^{fp2})^2 + (h_{i,2}^{fp2})^2 + (h_{i,3}^{fp2})^2\right].$$

Hence, it is straightforward to check that

$$\frac{\partial U^{fp2}(\theta_i, \beta_i)}{\partial \beta_i} < \frac{\partial U^{np}(\theta_i, \beta_i)}{\partial \beta_i} < 0.$$

Lastly, we compare the indirect utilities under np and $sp2$. Note that

$$\begin{aligned}
U^{sp2}(\theta_i,\beta_i) =&[d_1+c_1\theta_i]h^{sp2}_{i,1}-\frac{1}{2}\beta_i(h^{sp2}_{i,1})^2\\
&+[d_1+c_1(2\theta_i+h^{sp2}_{i,1})]h^{sp2}_{i,2}-\frac{1}{2}\beta_i(h^{sp2}_{i,2})^2\\
&+[d_2+c_2\eta_1]h^{sp2}_{i,3}-\frac{1}{2}\beta_i(h^{sp2}_{i,3})^2\\
=&[d_1+c_1\theta_i](\eta_1-3\theta_i)+[d_2+c_2\eta_1]h^{sp2}_{i,3}-\frac{1}{2}\beta_i(h^{sp2}_{i,3})^2\\
&+c_1(\theta_i+h^{sp2}_{i,1})h^{sp2}_{i,2}-\frac{1}{2}\beta_i(h^{sp2}_{i,1})^2-\frac{1}{2}\beta_i(h^{sp2}_{i,2})^2.
\end{aligned}$$

By taking the derivative with respect to β_i with using $\frac{\partial h^{sp2}_{i,1}}{\partial\beta_i}=\frac{2c_1\theta_i}{(2c_1+2\beta_i)^2}=-\frac{\partial h^{sp2}_{i,2}}{\partial\beta_i}$, we have

$$\begin{aligned}
\frac{\partial U^{sp2}(\theta_i,\beta_i)}{\partial\beta_i}=&-\frac{1}{2}\left[(h^{sp2}_{i,1})^2+(h^{sp2}_{i,2})^2+(h^{sp2}_{i,3})^2\right]\\
&+c_1\theta_i\frac{\partial h^{sp2}_{i,2}}{\partial\beta_i}+c_1\frac{\partial h^{sp2}_{i,1}}{\partial\beta_i}h^{sp2}_{i,2}+c_1h^{sp2}_{i,1}\frac{\partial h^{sp2}_{i,2}}{\partial\beta_i}-\beta_i\frac{\partial h^{sp2}_{i,1}}{\partial\beta_i}h^{sp2}_{i,1}-\beta_i\frac{\partial h^{sp2}_{i,2}}{\partial\beta_i}h^{sp2}_{i,2}\\
=&-\frac{1}{2}\left[(h^{sp2}_{i,1})^2+(h^{sp2}_{i,2})^2+(h^{sp2}_{i,3})^2\right]\\
&+\frac{\partial h^{sp2}_{i,1}}{\partial\beta_i}\underbrace{\left[-c_1\theta_i+c_1h^{sp2}_{i,2}-c_1h^{sp2}_{i,1}-\beta_ih^{sp2}_{i,1}+\beta_ih^{sp2}_{i,2}\right]}_{=0}\\
=&-\frac{1}{2}\left[(h^{sp2}_{i,1})^2+(h^{sp2}_{i,2})^2+(h^{sp2}_{i,3})^2\right].
\end{aligned}$$

Hence, it is straightforward to check that

$$\frac{\partial U^{sp2}(\theta_i,\beta_i)}{\partial\beta_i}<\frac{\partial U^{np}(\theta_i,\beta_i)}{\partial\beta_i}<0.$$

Hence, as β_i increases, worker i becomes more likely to prefer np compared to any other case. It implies decreasing promotion rate from $j=1$ to $j=2$ as β_i increases. □

C.2 Proof of Proposition 2.

Consider a case in which $0=c_1<c_2=c_3=c$ and $0=d_3=d_2<d_1=d$. In this case, because $c_2=c_3$ and $d_2=d_3$, no worker has an incentive to excessively work for the promotion to $j=3$. Hence, $bp2$ is not relevant. Also, $h^{fp1}_{i,t}=h^{bp1}_{i,t}$ and $U^{fp1}=U^{bp1}$; $h^{fp2}_{i,t}=h^{bp3}_{i,t}$ and $U^{fp2}=U^{bp3}$. By computing each case, we obtain:

- $h_{i,1}^{np} = h_{i,2}^{np} = h_{i,3}^{np} = \frac{d}{\beta_i}$, and $U^{np} = \frac{3d^2}{2\beta_i}$, where $\frac{2d}{\beta_i} < \eta_1 - 3\theta_i$.

- $h_{i,1}^{sp1} = h_{i,2}^{sp1} = \frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - 2c_2^2}, h_{i,3}^{sp1} = \frac{2cd + 3c\beta_i\theta_i}{\beta_i^2 - 2c_2^2}$, $U^{sp1} = 2d\left(\frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - 2c^2}\right) - \beta_i\left(\frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - 2c^2}\right)^2 + \frac{1}{2\beta_i}\left(\frac{2cd + 3c\beta_i\theta_i}{\beta_i^2 - 2c^2}\right)^2$, where $\frac{\eta_1}{2} - \frac{3}{2}\theta_i < \frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - 2c^2} < \eta_1 - 2\theta_i$.

- $h_{i,1}^{sp2} = h_{i,2}^{sp2} = \frac{\eta_1}{2} - \frac{3}{2}\theta_i, h_{i,3}^{sp2} = \frac{c\eta_1}{\beta_i}$, and $U^{sp2} = 2d\left(\frac{\eta_1}{2} - \frac{3}{2}\theta_i\right) - \beta_i\left(\frac{\eta_1}{2} - \frac{3}{2}\theta_i\right)^2 + \frac{c^2\eta_1^2}{2\beta_i}$.

- $h_{i,1}^{fp1} = \frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}, h_{i,2}^{fp1} = \frac{c(d\beta_i + 2\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}, h_{i,3}^{fp1} = \frac{c(d\beta_i + 3\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}$, $U^{fp1} = d\left(\frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}\right) - \frac{\beta_i}{2}\left(\frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}\right)^2 + \frac{1}{2\beta_i}\left(\frac{c(d\beta_i + 2\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}\right)^2 + \frac{1}{2\beta_i}\left(\frac{c(d\beta_i + 3\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}\right)^2$, where $\eta_1 - 2\theta_i < \frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2} < \eta_2 - 3\theta_i$.

- $h_{i,1}^{fp2} = \eta_1 - 2\theta_i, h_{i,2}^{fp2} = \frac{c\eta_1}{\beta_i}, h_{i,3}^{fp2} = \frac{c(\eta_1 + \theta_i)}{\beta_i}$, $U^{fp2} = d(\eta_1 - 2\theta_i) - \frac{\beta_i}{2}(\eta_1 - 2\theta_i)^2 + \frac{c^2\eta_1^2}{2\beta_i} + \frac{c^2(\eta_1 + \theta_i)^2}{2\beta_i}$, where $\eta_1 + \theta_i < \eta_2$.

- $h_{i,1}^{bp1} = \frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}, h_{i,2}^{bp1} = \frac{c(d\beta_i + 2\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}, h_{i,3}^{bp1} = \frac{c(d\beta_i + 3\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}$, $U^{bp1} = d\left(\frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}\right) - \frac{\beta_i}{2}\left(\frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}\right)^2 + \frac{1}{2\beta_i}\left(\frac{c(d\beta_i + 2\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}\right)^2 + \frac{1}{2\beta_i}\left(\frac{c(d\beta_i + 3\beta_i^2\theta_i + c^2\theta_i)}{\beta(\beta_i^2 - 2c^2)}\right)^2$, where $\frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2} > \max\{\eta_1 - 2\theta_i, \eta_2 - 3\theta_i\}$.

- $h_{i,1}^{bp3} = \eta_1 - 2\theta_i, h_{i,2}^{bp3} = \frac{c\eta_1}{\beta_i}, h_{i,3}^{bp3} = \frac{c(\eta_1 + \theta_i)}{\beta_i}$, $U^{bp3} = d(\eta_1 - 2\theta_i) - \frac{\beta_i}{2}(\eta_1 - 2\theta_i)^2 + \frac{c^2\eta_1^2}{2\beta_i} + \frac{c^2(\eta_1 + \theta_i)^2}{2\beta_i}$, where $\eta_1 + \theta_i > \eta_2$.

Suppose $c = 0.1$, $d = 0.02$, $\eta_1 = 1$, $\eta_2 = 1.5$, $\beta_{female} = 2$, $\beta_{male} = 1.8$, and $\underline{\theta} < 0.3$. In this case, for both male and female workers, promotion to $j = 2$ at some period is determined by comparing between U^{np} and U^{sp2}, whereas promotion to $j = 3$ is determined by the condition $\eta_2 = 3\theta_i + \frac{d\beta_i + 5c^2\theta_i}{\beta_i^2 - 2c^2}$ (and other conditions for promotions/non-promotions are satisfied). Also, female workers are promoted to $j = 2$ at some period if and only if $\theta \geq 0.3036$, while male workers are promoted to $j = 2$ at some period if and only if $\theta \geq 0.3003$. Also, female workers are promoted to $j = 3$ if and only if $\theta \geq 0.4946$, while male workers are promoted to $j = 3$ if and only if $\theta \geq 0.4937$.

Note that the promotion rate from $j = 2$ to $j = 3$ for female workers is $\frac{\bar{\theta} - 0.4946}{\bar{\theta} - 0.3036}$, whereas the one for male workers is $\frac{\bar{\theta} - 0.4937}{\bar{\theta} - 0.3003}$. By comparing these two, the latter is higher than the former if $\bar{\theta} \geq 0.57$. For example, when $\bar{\theta} = 1$, the promotion rate from $j = 2$ to $j = 3$ for female workers is 72.57%, while that for male workers is 72.35%. □

C.3 Proof of Proposition 3.

Consider a case in which $0 = c_1 = c_2 < c_3 = c$, $0 = d_3 < d_2 = d_1 = d$, and $\eta_1 + \theta_i > \eta_2$ for all θ_i. In this case, no worker has an incentive to excessively work for the promotion to $j = 2$, so $fp2$ and $sp2$ are not relevant. Because $\eta_1 + \theta_i > \eta_2$, $bp2$ is not relevant. Also, $h^{np}_{i,t} = h^{sp1}_{i,t} = h^{fp1}_{i,t}$ and $U^{np}_{i,t} = U^{sp1}_{i,t} = U^{fp1}_{i,t}$. By computing relevant cases, we obtain:

- $h^{sp1}_{i,1} = h^{sp1}_{i,2} = h^{sp1}_{i,3} = \frac{d}{\beta_i}$, and $U^{sp1} = \frac{3d^2}{2\beta_i}$, where $\frac{d}{\beta_i} < \eta_1 - 2\theta_i$.
- $h^{bp1}_{i,1} = \frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - c^2}$, $h^{bp1}_{i,2} = \frac{d}{\beta}$, $h^{bp1}_{i,3} = \frac{c(d+3\beta_i\theta_i)}{\beta_i^2 - c^2}$, and $U^{bp1} = d\left(\frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - c^2}\right) - \frac{\beta_i}{2}\left(\frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - c^2}\right)^2 + \frac{d^2}{2\beta_i} + \frac{1}{2\beta_i}\left(\frac{c(d+3\beta_i\theta_i)}{\beta_i^2 - c^2}\right)^2$, where $\frac{d\beta_i + 3c^2\theta_i}{\beta_i^2 - c^2} > \eta_1 - 2\theta_i$.
- $h^{bp3}_{i,1} = \eta_1 - 2\theta_i$, $h^{bp3}_{i,2} = \frac{d}{\beta_i}$, $h^{bp3}_{i,3} = \frac{c(\eta_1+\theta_i)}{\beta_i}$, $U^{bp3} = d(\eta_1 - 2\theta_i) - \frac{\beta_i}{2}(\eta_1 - 2\theta_i)^2 + \frac{d^2}{2\beta_i} + \frac{c^2(\eta_1+\theta_i)^2}{2\beta_i}$, where $\eta_1 + \theta_i > \eta_2$.

Suppose $c = 0.192$, $d = 0.154$, $\theta_{male} = 0.082$, $\beta_{male} = 0.35$, $\theta_{female} = 0.085$, $\beta_{female} = 0.3546$, $\eta_1 = 1$, and $\eta_2 < \eta_1 + \theta_{male}$. In this case, the male worker chooses $h^{bp3}_{i,t}$ so that he is promoted to $j = 3$ in $t = 3$, whereas the female worker chooses $h^{sp1}_{i,t}$ and she is promoted to $j = 2$ in $t = 3$. Also, $\eta_{male,3} = 1.082$ and $\frac{d_3 + c_3\eta_{male,3}}{\beta_{male}} = 0.594$, whereas $\eta_{female,3} = 1.124$ and $\frac{d_3 + c_3\eta_{female,3}}{\beta_{female}} = 0.608$. $\square$