

GRIPS Discussion Paper 23-13

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Evidence from Japan**

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February 2024



GRIPS

NATIONAL GRADUATE INSTITUTE
FOR POLICY STUDIES

National Graduate Institute for Policy Studies
7-22-1 Roppongi, Minato-ku,
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The Gender Wage Gap over the Life Cycle: Evidence from Japan

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Abstract

The gender wage gap is a persistent and pervasive issue that has received significant attention from economists, policymakers, and the general public. Despite efforts to close the gap, it remains a challenge to quantify and understand the sources of this disparity. In this paper, we aim to shed light on the gender wage gap over the life cycle, using data from the Basic Survey on Wage Structure (BSWS) in Japan. This data provides rich information on the wages of employees and offers a unique opportunity to examine the pattern of the gender wage gap across different age groups. The findings indicate that the wage gap widens significantly with age and is most pronounced among highly educated individuals. These results align with Goldin et al. (2017)'s research. Additionally, our study reveals that the gap for high-education worker lessens when controlling for manager-level positions, suggesting that a significant portion of the wage gap for the high-education can be ascribed to the under-representation of women in these roles. Our quantile analysis also demonstrates that the growing wage

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[§]We are grateful to Masanori Kashiwagi, Ayako Kondo, Keisuke Otsu and Tony Sit for comments. This paper has benefited from presentations at the GRIPS 2023 Macro Workshop and the Asian & Australasian Society of Labour Economics 2023 Conference. This paper also has been financially supported by GRIPS Policy Research Center and JSPS KAKENHI Grant Numbers 21K01439, 20K01593, and 22K13421. The BSWS data used in this study were provided by the MHLW in accordance with the provisions of Article 33, Paragraph 1 of the Statistics Law (Law No. 53 of 2007).

gap among older high-wage earners significantly contributes to the overall pattern of gender wage gap.

JEL Classification:

Keywords: Life-cycle earnings, Gender earnings gap, Japan

1 Introduction

The gender wage gap is a long-standing issue that has received considerable attention from economists, policymakers, and the general public. Despite progress in reducing the gap, it remains a significant challenge to fully understand its sources and to develop effective policies to address it. Understanding the pattern of the gender wage gap over the life cycle is crucial in this context, as it sheds light on how the gap evolves over time and provides insights into its sources. In this paper, we aim to contribute to the literature by examining the pattern of the gender wage gap over the life cycle in Japan, using data from the Basic Survey on Wage Structure (BSWS).

Recent research has also focused on the life cycle pattern of the gender wage gap, with the aim of understanding its evolution over time and the interaction between different factors that contribute to the gap. For example, Goldin et al. (2017) find that the gender earnings gap widens over the life cycle and is greater among college graduates than others, suggesting that factors such as human capital, labor market experience, and discrimination interact to shape the gender wage gap over the life cycle. In addition, Blau and Kahn (2017) show the long-term trend of the gender wage gap from 1955 to 2010. The gap has been substantially reduced in the 80s and the 90s, but it remains and has been stable since 2000s.

This study delves into the examination of the gender wage gap in Japan over the life cycle. Using the highly informative Basic Survey on Wage Structure (BSWS) data collected by the Japanese Ministry of Health, Labour, and Welfare (MHLW), the study aims to shed light on the patterns of the gender wage gap in Japan. The BSWS database is a large sample government statistical database with over a million data samples collected annually, making it an excellent source of information on employee wages in Japan.

We also find that the gender wage gap widens as age increases, reaching its peak at around 50 years old in Japan. This growing pattern is particularly pronounced among those with higher education levels. Although our study does not find that the gap is greater among college graduates in all age groups, it widens quickly and becomes greater than others from age 40 to 59. Our benchmark results are in line with those of Goldin et al. (2017), who found

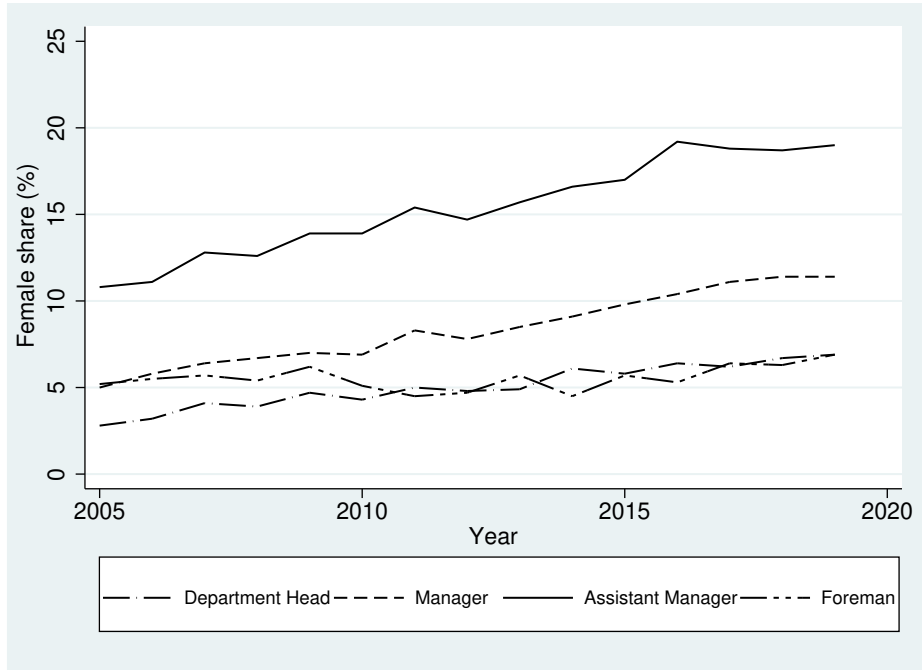


Figure 1: Female share of each managerial position

that the gender earnings gap widens over the life cycle and that the increased gap is greater among college graduates than others.

Furthermore, one distinguishing feature of Japanese labor market is that the proportion of women among managers is very low. It is much lower compared with that in Western countries. Yamaguchi (2016) has mentioned that the proportion of women among managers exceeds 30% in most European countries and 40% in the United States, but is only about 10% in Japan. Based on our sample from the BSWs data, we also compute the female shares of major managerial positions in Japan, including department head, manager, assistant manager, foreman (team leader), over the period from 2005 to 2019 (see Figure 1). We also observe that although the proportions of women among those managerial positions have increased, they are generally below 20%. In fact, except the proportion among assistant managers, all others are generally below 10%. Given that managerial positions are often dominated by men in Japan, we would like to discover how this fact impacts the gender wage gap. When we control for whether an individual is in manager-level positions in addition to the benchmark model, we find that managerial positions signif-

icantly increase the wage rate, and the (unexplained) gender wage gaps of college and high school graduates becomes less than those below high school in all ages. This finding implies that male workers with high-education levels are more likely to become managers than high-education female workers, and so the additional control for managerial positions can explain a significant portion of the gender wage gap. Our finding is also supported by the evidence documented in Yamaguchi (2016): white-collar regular employees with more than 30 years of employment duration, about 80% of male college graduates and about 70% of male high school graduates attain managerial positions, while by contrast, only 30% of female college graduates and less than 15% of female high school graduates attain managerial positions.

Additionally, we also study gender gap over the wage distribution in each age group by applying the approach used in Chernozhukov et al.(2013). We find that the gender gap is relatively small for younger age groups and in the bottom and middle of the distribution and becomes substantial among the top of the wage distribution in older age groups. This finding implies that the widening gender wage gap over the life cycle is mainly driven by the enlarged gap between high-wage male and female workers.

The remainder of the paper is organized as follows. Section 2 describes the data. Section 3 presents our empirical models and findings, and Section 4 concludes.

2 Data

This study leverages individual-level data from the Basic Survey of Wage Structure (BSWS), an annual survey conducted by Japan's Ministry of Health, Labor and Welfare (MHLW). The BSWS comprehensively surveys wages across all industries in Japan each June and provides information on factors such as salaries, employment status, job category, gender, age, education, years of service, and experience.

The survey includes private establishments with five or more regular employees and public establishments with ten or more, spanning all industries as classified under the Japan Standard Industrial Classification. It provide information on business type, number of workers by gender, number of workers in

the enterprise, as well as individual worker characteristics such as gender, job type, education, age, working days and hours, cash wages, and exceptional cash wages. The BSWS uses a stratified two-stage sampling method with establishments as the primary units and workers as secondary units.

With permission from the MHLW, this study utilized BSWS data from 2005 to 2019. The BSWS data has several advantages, such as wage and working hour records based on payroll rather than self-reporting, providing accurate data on monthly wages, overtime pay, bonuses, benefits, hours worked, and overtime. Additionally, with large sample sizes (e.g., 882,648 in 2005 and 870,804 in 2019), the data set offers a comprehensive understanding of the Japanese labor market. Limitations include a lack of information such as marital status or number of children, as data is sourced from payroll records, and the data are repetitive cross-sectional data.

In this study, the sample selection process was shaped by the nature of the labor market and the available data. Specifically, the age limit was set at 65 years or younger, in line with the prevalent practice of mandatory retirement ages between 60 and 65 in many Japanese companies. The analysis is confined to "regular" employees, referring to those hired for an indefinite period or for a duration of at least one month. The decision to exclude temporary workers was necessitated by the lack of their educational background data in the BSWS. Lastly, to account for the influence of bonuses, a significant component of wage compensation in Japan, the sample was further narrowed to include only workers who had served at least one year at the same work-site.¹ This step was necessary given that the BSWS does not provide data on bonuses for workers with less than a year's service.

¹The importance of including bonuses has been discussed in the literature (see for example, Freeman and Weitzman, 1987 Hart and Kawasaki, 1999, Hashimoto, 1979).

3 Empirical Analysis

3.1 Basic Regression Model

We analyze data by individual (i) in age group (j) with education level (k) from 2005 to 2019. We estimate the following equations:

$$\ln(y_{ijkt}) = \alpha_{jk} + X\beta + \rho_{jk}F_{ik} + \gamma_t + \varepsilon_{ijkt}, \quad (1)$$

where y_{ijkt} is mean hourly wage for individual i in age group j with education level k at time t ; X is a vector of individual/firm characteristics; F is an indicator which is one if individual i is female and zero otherwise. In the model, α_{jk} captures the variation in log wage rates across age and education groups, γ_t is to control for aggregate year effects, and ε_{ijkt} is the error term. Our primary focus is on the coefficient ρ_{jk} , which indicates the gender wage gap, as a percentage, by age and education. A negative value of ρ implies that female hourly wages are lower than male wages by the percentage indicated by ρ .

3.2 Gender Wage Gap over the Life Cycle – Benchmark

In our benchmark specification, the individual characteristics vector X includes a full-time dummy, a regular (tenured) worker dummy, years of experience in the same office, industry dummies, company size dummies and region dummies.

Figure 2 presents the results of the (unexplained) gender wage gap, measured by ρ_{jk} from the regression, by age and education level under the benchmark specification. Although the value of the gap (ρ_{jk}) changes with age, it is consistently negative, highlighting a persistent wage disparity where women are paid less than their male counterparts across age and education groups. We also find that the gender wage gap increases significantly with age (until age 59) for all education groups in Japan.

Among the three education groups, the gender wage gap for college graduates is the lowest at 6.2% for ages 20-24. However, it increases more rapidly than the other groups, reaching 34.4% for ages 45-49 and 36.4% for ages 50-54. The gap for high school graduates starts at 11.6% for ages 20-24, which

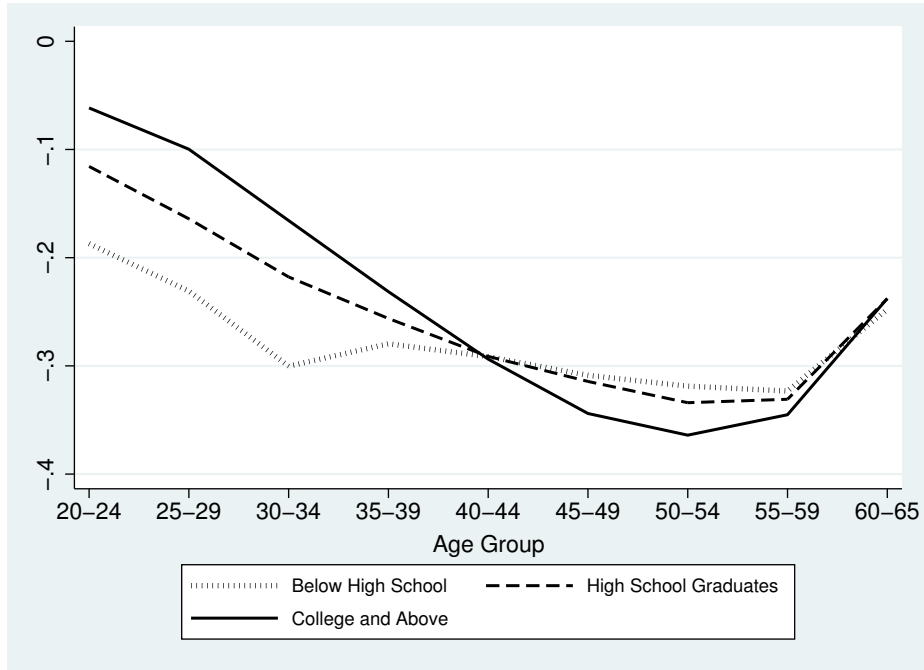


Figure 2: Gender wage gap by age (benchmark specification)

is lower than that for individuals with less than a high school education but higher than that for college graduates. It then rises to 31.4% for ages 45-49 and 33.3% for ages 50-54. The gender wage gap for those with less than a high school education follows a similar but flatter pattern over the life cycle, starting with a larger initial gap (18.7% for ages 20-24) and a slower growth rate over age, reaching 32.3% for ages 50-54, compared to college and high school graduates. These results align with Goldin et al. (2017)'s findings in the US.

We have also conducted several robustness checks. Firstly, we ran the regression using subsamples of regular workers only and full-time workers only. The results exhibit similar patterns: gender wage gaps increase with age, and the gap for college graduates starts with the lowest initial gap but shows the highest growth rate over age. In contrast, the gap for those with less than a high school education begins with the highest initial gap but has the lowest growth rate over age.

Additionally, we ran the regression for each year to assess whether the patterns are stable over time. Figure 3 presents the results for selected years

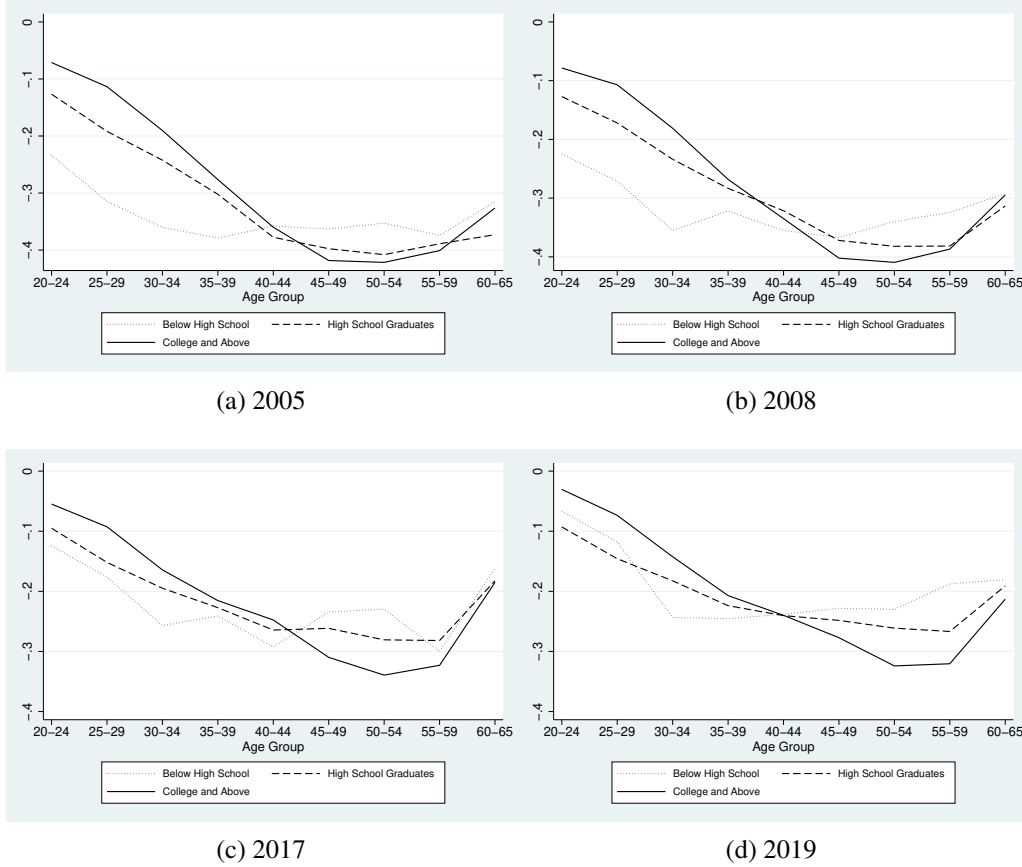


Figure 3: Robustness check: gender wage gap by age in each year (benchmark)

(2005, 2008, 2017, and 2019). It is evident that the life-cycle patterns of the gender wage gap for each education group generally persist over time, although the overall level of the gaps reduces. For instance, in 2005, the gender wage gap for high school graduates started at over 10% for ages 20-24 and increased to more than 40% for ages 50-54. In contrast, in 2019, the initial gap for high school graduates was less than 10% for ages 20-24 and less than 30% for ages 50-54.

3.3 Extension – Managerial Positions

Furthermore, given that managerial positions are often dominated by men in Japan, we aim to explore how this fact impacts the gender wage gap. Yam-

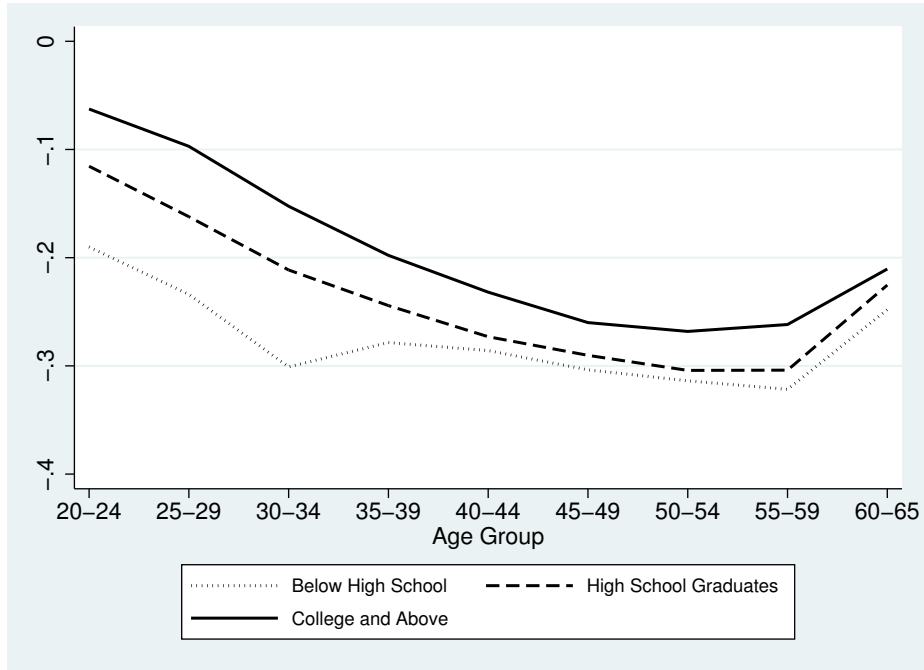


Figure 4: Gender wage gap by age (control for managerial positions)

Yamaguchi (2016) documented that among white-collar regular employees with more than 30 years of employment duration, approximately 80% of male college graduates and about 70% of male high school graduates attain managerial positions, while only 30% of female college graduates and less than 15% of female high school graduates do so. The theoretical framework in Coate and Tennyson (1992) is applicable to this case in Japan. Suppose that the wage for a manager is w_h and the wage for other employees is w_l , where $w_h > w_l$. The probability of a man obtaining a managerial position is π_m , and the probability of a woman with comparable ability/experience obtaining such a position is π_f . Due to "testing errors," as first discussed in Phelps (1972) and Aigner and Cain (1977), or simply due to employer preferences as in Becker (1971), we have $\pi_m > \pi_f$ as found in Yamaguchi (2016). As a result, men's expected wage is $w_m = \pi_m w_h + (1 - \pi_m)w_l$ and women's expected wage is $w_f = \pi_f w_h + (1 - \pi_f)w_l$. This leads to a gender wage gap, as it is obvious $w_m > w_f$ given that men have a much higher chance of becoming managers ($\pi_m > \pi_f$).

Therefore, in addition to those factors in X in the benchmark specifica-

tion, we control for whether an individual is in manager-level positions. We consider the following five managerial positions: general manager, section manager, assistant manager, factory chief, and other managerial positions. In the regression, we use additional five dummy variables to control for whether an individual is obtaining these managerial positions.

We find that managerial positions significantly increase the wage rate. Compared with people in non-managerial positions, being in a general manager position increases the hourly wage by 46.9%, a section manager position by 31.0%, an assistant manager position by 12.5%, a factory chief position by 11.2%, and other managerial positions by 21.4%. All these increases are significant at the 1% level. Furthermore, after controlling for managerial positions, the unexplained gender wage gaps for college and high school graduates become smaller than those for individuals below high school at all ages, as shown in Figure 4. This finding confirms that male workers with higher education levels are more likely to be in managerial positions than their female counterparts with the same education level, and this difference significantly contributes to the gender wage gap from the middle of the life cycle (from age 40) in Japan.

3.4 Gender Gap across the Wage Distribution

In the empirical analysis of labor economics, examining the evolution of the gender wage gap across the entire wage distribution using cross-sectional data over time is an issue of considerable importance, as reflected in the works of Firpo, Fortin, and Lemieux (2018) and Hara (2018). The econometric methodologies required to analyze the gender wage gap across the wage distribution have been primarily developed by Firpo, Fortin, and Lemieux (2009) and Chernozhukov, Fernandez-Val, and Melly (2013). The former is predicated upon the framework of unconditional quantile regression, while the latter is based on distribution regression. Both methods represent a departure from traditional mean regression techniques, offering a more complete understanding of the disparities in wage distribution across quantiles.

The empirical findings in our study from the application of Firpo et al.'s methodology yielded results consistent with those derived using the technique

by Chernozhukov et al. Consequently, we have chosen to showcase only the estimates obtained through Chernozhukov et al.'s robust nonparametric method. Chernozhukov et al.'s methodology allows for a more thorough understanding of the wage gap, as it considers the entire wage distribution. This is important because the gender wage gap might manifest differently at different wage levels; for example, it might be larger at the top of the wage distribution than at the bottom.

In our analysis, we first segmented the data associated with the full-time workers by age into three groups: 20-35, 35-50, and 50-65 years old. The control variables included in the cross-sectional model specification are years of education, years of experience in the same office, the square of years of experience in the same office, a regular (tenured) worker dummy, industry dummies, managerial position dummies, and a family allowance dummy. Figure 5 illustrates the changes in the gender wage gap across the entire wage distribution for these three age groups in the years 2005, 2014, and 2019. Between 2005 and 2019, the gender wage gap exhibited a trend of improvement across the three designated age brackets. Specifically, the age cohorts of 35-50 and 50-65 saw the most pronounced reduction in gender wage gap, primarily in the lower and middle segments of wage distribution. Nonetheless, in 2019, there was a discernible widening of the gender wage gap at the upper tail of the wage distribution for individuals in the 50-65 age cohort.

If we examine the gender wage gap on an annual basis for the 20-35 and 35-50 age groups, it becomes evident that the 35-50 cohort consistently exhibits a larger gender wage gap across the entire wage distribution when compared to the 20-35 cohort, indicated by its curve consistently positioned lower on the graph. The observed pattern suggests that the gender wage gap widens with age, aligning with our earlier analytical findings. However, this comparison does not juxtapose the same age cohorts. An accurate approach would require panel data that allows for tracking a consistent cohort over time for comparison. Given the structure of the data currently available to us, a more approximate method of comparison can be employed. For instance, if we consider the 20-35 age cohort in 2005, this group would roughly correspond to the 35-50 age cohort in 2019, 15 years later. Thus, when comparing the gender wage gap across the entire wage distribution for the 2019 cohort aged

35-50, the entire curve also falls below that of the 2005 cohort aged 20-35, further supporting the conclusion that the wage gap increases with age.

In summary, we find that the gender gap is relatively small for younger age groups and in the bottom and middle of the distribution and becomes substantial among the top of the wage distribution in older age groups. This finding implies that the widening gender wage gap over the life cycle is mainly driven by the enlarged gap between high-wage male and female workers.

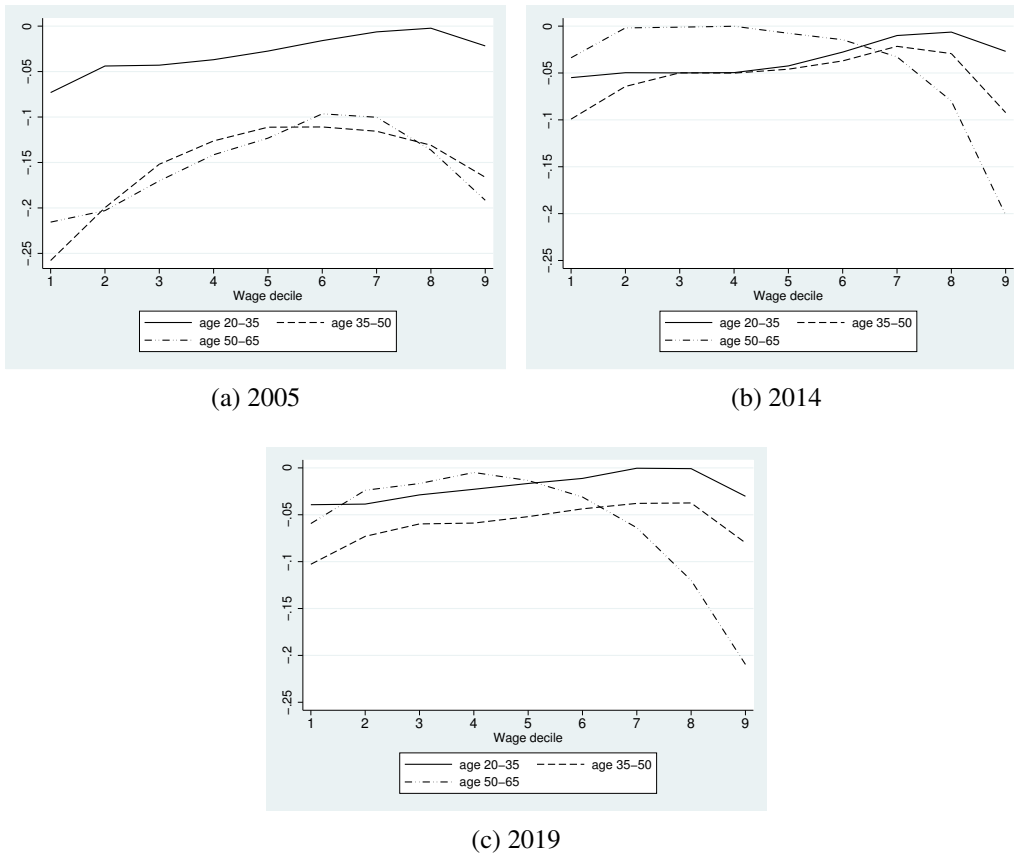


Figure 5: Gender gap across the wage distribution

4 Concluding Remarks

In this paper, we have undertaken a comprehensive exploration of the gender wage gap throughout the life cycle within the Japanese labor market. Utilizing

the comprehensive Basic Survey on Wage Structure (BSWS), we have been able to reveal patterns and nuances of the gender wage gap that further enrich our understanding of this persisting issue.

Our research, aligned with Goldin et al. (2017), confirms the widening of the gender wage gap with increasing age, with this pattern being more pronounced among individuals with higher education levels.

An essential contribution of our research has been the investigation of the role of managerial positions in the gender wage gap. We found that a significant proportion of the wage gap can be attributed to the overrepresentation of males in these higher-paying roles, particularly those with high educational levels. This finding indicates the need for interventions focused on enhancing female representation in managerial positions as a means of reducing the wage gap.

Taking our analysis further, we delved into the gender wage gap across the wage distribution for each age group, following the approach of Chernozhukov et al. (2013). The gender gap was found to be relatively minor in younger age groups and among those in the lower and middle segments of the wage distribution. However, it becomes substantial among high-wage workers in older age groups. This finding suggests that the life-cycle widening of the gender wage gap is predominantly driven by the growing discrepancy between high-wage male and female workers. This result further indicates that policies for reducing the gender wage gap need to specifically address the disparities in this segment, for example, promoting transparency in pay scales, enforcing equal pay legislation, and encouraging work-life balance.

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