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Retirement policy, employment status, and gender pay gap in urban China

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ABSTRACT

China's current retirement policy has been in effect since 1978. The legal retirement age is 50 years for female workers, 55 years for female cadres, and 60 years for male cadres and workers; women can retire 5 or 10 years earlier than men. This difference in legal retirement age may affect wage growth in those approaching retirement. Based on China's Urban Household Survey data set, this study investigated the influence of retirement age differences on the gender pay gap. From age 30 to 49 years, the wage difference between female workers and cadres increased by approximately 15 % more than that of men. After consideration of possible endogeneity problems and demonstration of the robustness of the regression results, the study determined that such differences were likely caused by gender and identity differences at retirement age. Among workers and cadres, the retirement age policy exacerbated gender differences in wages through working hours, wage rate, career promotion, and job change activity in those approaching retirement.

1. Introduction

China's current retirement policy has been in effect since 1978. The legal retirement age is 50 years for female workers, 55 years for female cadres, and 60 years for male cadres and workers; women can retire 5 or 10 years earlier than men. In practice, early retirement and re-employment after retirement occur, but the vast majority of China's urban labor force retires in accordance with this policy. Empirical studies have reported a significantly increased probability of retirement at 50 and 55 years for urban female workers and urban female cadres, respectively, and at age 60 for men (Feng et al., 2017; Giles et al., 2015).

This gender-differentiated retirement age policy based on differences in employment status may lead to problems in the labor market, outside the labor market, or in the pre-labor market. First, this policy may lead to gender-specific pension differences. If all citizens commence employment at the same age, earlier retirement results in a shorter working age, which affects wages before retirement. Zhao and Zhao (2018) analyzed data from the China Health and Retirement Longitudinal Study and revealed that the working age of retirees significantly affects their pension benefits. For every yearly increase in working age, pension benefits increase by 1.2 % and 1.82 % for men and women, respectively. Zheng and Yang (2009) determined that, for male and female employees with the same salary, women's pensions may only be 40 % that of men's because of this difference in retirement age.

Second, the aforementioned difference in retirement age may affect education investment before labor market entry. China's legal retirement age influences society's subjective perception of the "appropriate" retirement age (Bottazzi et al., 2006). Accordingly, a

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raising of the retirement age may affect individuals' education decisions by influencing the time at which they receive a pension, their marginal tax rate, and even their lifetime wealth (Mastrobuoni, 2009).

Third, differences in retirement age may lead to differences in wages and job promotion opportunities. When they approach retirement age, the work motivation of employees may be reduced, and they may minimize their engagement in human capital investment–related behaviors (e.g., on-the-job training, active seeking of job transitions); this would affect individuals' accumulation of wages (Light & Ureta, 1995; Manning & Swaffield, 2008; Mincer & Ofek, 1982). Enterprises may discriminate against employees approaching retirement by providing limited opportunities for on-the-job training and career promotion (Mincer & Polachek, 1974). This study investigated the impact of gender-differentiated retirement age policies on gender wage gaps.

Through the use of China Urban Household Survey (UHS) data from 2002 to 2009, this study analyzed the effect of differentiated retirement age on the gender wage gap and the possible influencing channels. Simply comparing the gender wage growth gap by age is insufficient for determining whether this gap is affected by retirement age policies or other factors. Moreover, an individual's retirement age depends on their gender and employment position. When they approach age 50 years, the difference in wages between female workers and cadres may change partly because of differences in retirement age, but male workers and cadres who both retire at age 60 years are not affected by the policy. *Ceteris paribus*, by comparing the wage growth differences between female cadres and workers with that of male cadres and workers, this study investigated whether China's gender-differentiated retirement age policy affected the gender pay gap.

Employees in enterprises or public institutions were defined as workers or cadres in accordance with their job characteristics. Triple difference regression was performed to analyze related differences. The coefficients for the triple intersection of gender, age, and employment position reflected the gender gap in wage growth differences between cadres and workers with one additional age increase. With consideration for possible endogeneity problems, characteristics such as regional economic and employment factors were controlled, and instrumental variable–triple difference regression was performed. Robustness tests were also conducted by distinguishing between different types of samples to test this study's hypothesis.

The findings indicated that the wage difference between female workers and cadres increased by an average of 0.79 % for every year of age than that between male workers and cadres. The wage gap between workers and cadres was approximately 10.7 % for women and 4.53 % for men at age 30 years, and it increased to 30.46 % for women and 9.28 % for men at age 49 years, respectively. From age 30–49 years, the wage difference between female workers and cadres increased by approximately 15 % more than that for male workers and cadres. After possible endogeneity problems were considered and the robustness of the regression results was tested, the present study indicated that such differences were likely caused by gender and employment differences at retirement age. The gender difference in labor participation, wages, job mobility, and career promotion opportunities as retirement age is approached may have caused this increase in wage differences.

This research has the following contributions. First, researchers have discussed the sources of wage differences from various perspectives, including endowment, return differences, and market and policy factors (Gustafsson & Li, 2000; Liu et al., 2000). The present study provides another possible explanation for wage differences in the labor market, namely China's retirement age policy. Second, studies on retirement age have mainly focused on gender differences in pension after retirement. The present study systematically assessed the possible impact of China's retirement age policy on the labor market and examined the potential influencing channels. The results have implications for policymakers.

2. Background

In 1978, China's State Council issued a document stipulating China's statutory retirement age. China's legal retirement age is specified by "The Interim Measures of the State Council on the Placement of Old, Weak, Sick, and Disabled Cadres" and "Interim Measures of the State Council on Workers' Retirement and Resignation" (Guo Fa [1978] No. 4), which were approved in principle at the second meeting of the Standing Committee of the Fifth National People's Congress on May 24, 1978. The documents indicated that the legal retirement age for employees is 60 years for male workers and cadres, 50 years for female workers, and 55 years for female cadres. Since 1978, China's enterprises and public institutions have followed this policy, with some notable exceptions. For those engaged in underground, high-altitude, high-temperature, and burdensome physical labor, or other work harmful to health, the retirement age is 55 years for men and 45 years for women. For those who are disabled, as certified by a hospital and confirmed by the Labor Appraisal Committee, the retirement age of employees of enterprises is 55 years for men and 45 years for women; the relevant retirement age is 50 years for men and 45 years for women employed by the government.

After 1992, the labor law specified that cadres are engaged in professional, technical, or managerial jobs, whereas workers are engaged in nontechnical or nonmanagerial jobs. The determination of the retirement age of female employees is based on their professional role. For female employees engaged in technical or managerial jobs before retirement, the retirement age is 55 years. For female employees engaged in nonmanagerial or nontechnical jobs, the retirement age is 50 years.

China's retirement policy stipulates that the retirement age applies to workers covered by the urban employee pension insurance system and government agencies and institutions. In 1997, the State Council established a pension system for urban enterprise employees, and it has since gradually expanded its coverage to include non-state-owned enterprises. From 2000 to 2017, the proportion of insured employees in the employed urban population increased from 45.1 % to 68.7 %. The legal retirement age for employees of government agencies and institutions is the same in the retirement system.

Some private companies do not actively participate in the social insurance system or comply with retirement policies. Data from the 2018 "China Enterprises Social Insurance White Paper" indicate that, among the thousands of companies surveyed, only 27 % participated in the social security system and fully complied with relevant regulations. A considerable number of private companies

either do not participate in the social insurance system for their employees or participate in the social insurance system but pay low fees. Evidently, private companies have not strictly enforced the retirement age stipulated in the policy. Underpayment of social security fees by numerous companies is a major reason for the heavy burden of social security.

3. Empirical strategy

According to the mandatory retirement age policy, employees of different types have varying retirement ages, and the remaining working time before retirement may affect individuals' wage growth, career promotion, and other indicators of labor market performance. To investigate the output difference among employees with predicted differences in retirement age, this study used age as the substitute variable for China's retirement age policy. Thus, if a person's current age is 45 years and the legal retirement age is 50 years, then that person's remaining working time is 5 years; if the legal retirement age is 55, that person's remaining working time is 10 years. At the age of 45 years, individuals with 10 years of remaining working time may perform differently in the labor market than would those with 5 years of remaining working time. Female cadres retire at 55 years, and female workers retire at 50 years, but male workers and cadres retire at 60 years. Only female cadres and workers have different retirement ages, and no difference in retirement age exists between male cadres and workers. Therefore, before age 50 years, the impact of retirement age on labor market performance should be significant for women but not men. Accordingly, by comparing wage growth differences of female cadres and workers with those of male cadres and workers, this study determined whether China's gender-differentiated retirement age policy affects the gender pay gap.

The age-dependent output difference between cadres and workers may be affected by unobservable factors, such as individual abilities, regional economic development, and diverse employment situations. These factors influence whether employees can become cadres. No difference exists between the retirement ages of male workers and cadres. Therefore, if the unobserved factors are the same for both men and women (e.g., men and women facing the same policy shocks or selection mechanisms for cadres and workers), the differences in wage growth between male cadres and workers can serve as a control group, thus removing the influence of possible unobserved factors in a female group. The estimated equation is as follows:

$$\begin{aligned}\ln\text{wage}_i = {} & \alpha + \beta_1 female_i + \beta_2 worker_i + \beta_3 age_i + \beta_4 female_i * worker_i + \beta_5 female_i * age_i + \beta_6 worker_i * \text{age}_i + \beta_7 female_i * worker_i \\ & * \text{age}_i + \varphi X_i + \gamma \nu_i + \varepsilon_i \end{aligned} \tag{1}$$

Where the explained variable is the logarithm of wage received by individual, representing the labor market's output; $female_i$equals 1 if the individual is female and equals 0 if the individual is male; $worker_i$ equals 1 if the individual is a worker and equals 0 if the individual is a cadre; and age_i is an individual's current age, which can be a continuous variable representing a specific age or a dummy variable equaling 0 for those far from retirement and 1 for those near retirement. The coefficients $\beta_4, \beta_5,$ andβ_6 are the cross terms of two variables for female, worker, and age, respectively. The coefficient β_7 is the cross-term of female, worker, and age.

The coefficients of each variable must be combined with other coefficients for analysis. For simplicity, this study supposed that the age variable here is a person's actual age minus 30 years. That is, the value of the age variable in the regression is 0–19 (equating to 30–49 years), as assumed in the empirical investigation of this study. Alternatively, age was regarded as a dummy variable: 1 for age 40–49 years and 0 for age 30–39 years. According to the equation, the logarithmic wages of male cadres at their initial age (age equal to 0 years) were used as the benchmark group. The gender wage gap (female minus male) at age 0 years is β_1 for cadres and $\beta_1 + \beta_4$ for workers. The wage gap between workers and cadres at age 0 years is β_2 for men and $\beta_2 + \beta_4$ for women. The wage growth from age 0–1 years, or each additional yearly age increase, is $\beta_3 + \beta_5$ for female cadres, $\beta_3 + \beta_5 + \beta_6 + \beta_7$ for female workers, β_3 for male cadres, and $\beta_3 + \beta_6$ for male workers. The difference in wage growth with each 1-year increase in age between workers and cadres is $\beta_6 + \beta_7$ for women and β_6 for men. A significant and negative coefficient indicates that the wage growth of workers is significantly lower than that of cadres for a specific gender. The coefficient β_7 represents the gender difference in wage growth between workers and cadres with an additional 1-year increase in age.

Suppose the subscript *w* represents workers, *c* represents cadres, *f* represents female, and *m* represents male. $\overline{\text{wage}}_{w,f,\text{age}_1}$ represents the average wage of female workers at age 1, and $\overline{\text{wage}}_{c,m,\text{age}_2}$ represents the average wage of male cadres at age 2; the coefficient β_7 of the triple interaction term can be written as follows:

$$\widehat{\beta}_7 = \left(\overline{\text{wage}}_{w,f,age_2} - \overline{\text{wage}}_{w,f,age_1}\right) - \left(\overline{\text{wage}}_{c,f,age_2} - \overline{\text{wage}}_{c,f,age_1}\right) - \left[\left(\overline{\text{wage}}_{w,m,age_2} - \overline{\text{wage}}_{w,m,age_1}\right) - \left(\overline{\text{wage}}_{c,m,age_2} - \overline{\text{wage}}_{c,m,age_1}\right)\right] \tag{2}$$

Eq. (2) represents the coefficient β_7 of the cross-term of female, worker, and age, indicating increases in the gender-differentiated wage growth gap between workers and cadres for each additional 1-year increase in age. Some omitted variables are subtracted that may simultaneously influence job selection and wage growth for men and women.

3.1. Possible endogeneity problems

The selection of positions between cadres and workers is not random; rather, it is affected by numerous factors, including personal characteristics, macroeconomic background, and regional economic development. Triple difference regression may not address all potential selection problems. This study controlled for the observable individual characteristics X_i in the equation to address some selection problems, including individual education level, marital status, ethnic minority status, number of children aged 0–3 years in the family, and occupation industry. Education is the most critical factor affecting employees' positions and wages. This study also

controlled for city-level variables ν_i, including city-level characteristics, city dummy variables, and the cross-section of city dummy variables with year dummy variables. The city's characteristics included the city's gross domestic product (GDP), unemployment rates, and economic structure.

In addition to controlling for personal and city-level variables for analysis, this study applied 2SLS regression to evaluate the robustness of the results, in which the primary instrumental variable was the proportion of cadres in a city. After controlling for relevant variables at the city level, the proportion of regional cadres was expected to affect the probability of individuals becoming cadres but to be unrelated to the missing variables in the wage equation affecting productivity. Because of the presence of cross terms between occupation position and other variables in the triple difference regression, the cross terms of the proportion of regional cadres and other variables were used as part of IVs. This variable satisfied the requirements of relevance and exogeneity for an effective IV group.

3.2. Assessment of bias caused by unobservable factors

Although this study attempted to control observable factors, the regression results of Eq. (2) may still have been affected by unobservable factors. As long as these factors were related to workers' position selection and their wages and have gender differences, estimation biases of the triple interaction term coefficient may still exist. Therefore, the extent to which unobservable factors cause bias was further assessed. This study applied the method of Altonji et al. (2005) to evaluate the impact of unobservable factors to analyze whether missing variables caused serious bias in the triple difference estimation. This approach fully demonstrates the influence of possible sample selection problems in regression by calculating the strength of bias potentially attributable to unobservable factors. In principle, compared with self-selection based on observable factors, self-selection based on unobservable factors must be considerably strong to explain all estimated effects. For comparing the coefficient difference ratio of the core explanatory variable in the restricted variables and full variables regressions of the control variables, the calculation formula is as follows:, where is the coefficient of the core variable in the restricted regression and is the coefficient of the core variable in the full variable regression. The smaller the difference between the coefficients of the restricted and full regressions presented in the denominator is, the less affected the coefficient estimate is by self-selection based on observable factors, and the less affected the estimated result is by sample selection. That is, a strong sample selection effect is necessary to explain the estimation result. Therefore, the higher the coefficient difference ratio is, the greater is the sample selection effect required to explain the effect, and the less affected the estimated result is by unobservable factors.

3.3. Subsample regression for a robustness test

By distinguishing between different types of samples, the present study can indirectly verify the hypothesis's rationality and the results' robustness. This study primarily distinguished between three types of samples to verify the basic results.

3.3.1. Classifying samples by enterprise type

Different enterprises enforce policies to various degrees. Policy documents indicate that state-owned economic units, foreign enterprises, joint-stock enterprises, and other formal enterprises implement the relevant retirement policy, whereas private and individual enterprises may not be strictly constrained by the policy. Therefore, the researchers suppose that β_7 should be nonsignificant for private and individual enterprises and be significant for other enterprises.

3.3.2. Considering education heterogeneity

Individuals with low educational attainment may have unobservable characteristics that differ from those of individuals with higher educational attainment. A person's actual education level may be affected by unobservable factors, such as learning ability, which will also affect wages. In the sample, the vast majority of low-education employees were workers. Therefore, to render the two groups of cadres and workers comparable, the samples were subcategorized by education level to verify the robustness of the results.

3.3.3. Considering industry heterogeneity

Occupational gender segregation may influence the extent of gender imbalance in various industries. Certain industries naturally have specific requirements for gender, or employers in occupational gender-segregated industries may treat different gender groups differently. These situations influence gender differences in employment opportunities and career development, which may affect wages separately to retirement policy. Therefore, the researchers distinguished non-gender-biased industries from other industries for the robustness test based on the gender proportion of age-appropriate people in different industries (according to UHS data). If significant results are obtained for non-gender-biased industries and other industries, then the gender wage growth gap may not be caused by the omitted variables related to occupation.

4. Data

4.1. Data introduction

This study mainly used UHS data to analyze the impact of retirement policy on gender wage differences. The UHS data are micro household data collected by the National Bureau of Statistics Urban Survey Team from 2002 to 2009. The research team conducted a detailed survey on the characteristics, income, and expenditure of urban households. UHS used a stratified sampling method to

Table 1
Descriptive analysis of samples (UHS data).

Variables	Males			Females		
	All	Workers	Cadres	All	Workers	Cadres
Sample size	82,945	54,620	28,325	66,004	44,904	21,100
Wage (yuan)	23,606.420	21,749.460	27,187.240	19,231.790	17,032.080	23,913.100
Wage (Yuan, logarithm)	9.868	9.783	10.031	9.633	9.505	9.904
Working hour (monthly)	176.976	177.475	175.911	173.252	173.353	173.016
Wage rate	10.601	9.822	12.264	9.146	8.248	11.253
Age	40.409	40.481	40.271	39.778	40.048	39.202
Married	0.972	0.969	0.978	0.960	0.958	0.965
Education (percentage)	1.000	1.000	1.000	1.000	1.000	1.000
Junior high school and below	0.143	0.192	0.048	0.136	0.185	0.031
High school/technical secondary school	0.337	0.402	0.212	0.402	0.464	0.269
Tertiary education	0.295	0.265	0.355	0.305	0.258	0.403
College and above	0.224	0.141	0.385	0.157	0.092	0.296

annually conduct random sampling across the country. However, instead of survey tracking, one-third of the regular survey households were replaced annually by new households selected from overall sample. The sampling areas covered 16 provinces and cities across China, namely Beijing, Shanghai, Chongqing, Yunnan, Anhui, Shandong, Liaoning, Gansu, Henan, Guangdong, Sichuan, Hubei, Heilongjiang, Jiangsu, Jiangxi, and Shaanxi. These areas are representative of China and vary substantially in geography and economic development indicators; therefore, UHS data are representative of the Chinese population.

According to the aforementioned analysis, the main analysis sample included employees working in government agencies and state-owned enterprises and institutions but did not include urban self-employed or private enterprise employees, retired re-employed people, and informal employees. Table 6 presents the difference in results between the two groups, as determined through a robustness test. In addition, the sample age was limited to 30–49 years. Because the legal retirement age is set at 50 and 55 years for women and 60 years for men, the earliest age at which someone can legally retire is 50 years. In addition, people have generally entered the labor market by age 30. In total, sample data from 148,949 individuals were obtained over 8 years, including 66,004 women (44.31 % of the total sample).

When defining workers or cadres, people often refer to the role specified in the last labor contract before retirement or the corresponding job responsibility. The legal retirement age is 55 years for management, professional, and technical positions and 50 years for nonmanagement positions. Following this classification standard, employees' current positions were distinguished based on Question a14 in the UHS (specific occupation).[1] This study regarded professionals, technicians, and heads of state agencies, enterprises, and institutions reported as types 1 and 2 in Question a14 as cadres, and other personnel, including ordinary employees, as workers. The proportions of men and women who were cadres were 34.15 % and 31.97 %, respectively. Individual incomes surveyed in the UHS data included annual wages as well as business, property, and transfer income. Given that this study mainly examined employed individuals, the annual wage was selected for regression.

4.2. Descriptive statistics

Table 1 provides a brief descriptive analysis of the UHS samples that distinguish gender and employment positions. On average, men earned approximately 22.7 % more than women. Male cadres earned approximately 25 % more than male workers, and female

[1] The classification items of the a14 variable in UHS data before 2007 are as follows: (1) All types of professional and technical personnel, including scientific researchers; engineering and technical personnel and agricultural and forestry technical personnel; science and technology administrative and auxiliary personnel; aircraft and ship technicians; health technicians; economic and business personnel; legal staff; teaching staff; workers in literature, art, and sports; cultural staff; and religious professionals. (2) Persons in charge of party and mass organizations of state organs, enterprises, and public institutions. (3) Clerical and managerial personnel, including administrative staff, political and security personnel, post and telecommunications personnel, other staff and associated personnel, and economic management professionals without professional titles or a university or technical secondary education. (4) Commercial staff, including sales, purchasing, supply and marketing, acquisition, and other commercial staff. (5) Service staff, including waiters, conductors, childcare workers, cooks, tour guides, daily necessity maintenance personnel, and other service staff (e.g., cleaning staff; hairdressers; and washing, dyeing, and weaving personnel). (6) Workers in agriculture, forestry, animal husbandry, and fishery (refer to personnel engaged in farming, forestry, animal husbandry and fishery production, operation of agricultural machinery, and hunting). (7) Production workers, transportation workers, and related personnel: section heads and various production workers, equipment operators, drivers, sailors, other production and transportation workers, and related personnel. (8) Other workers that are difficult to classify (refers to personnel not in the preceding seven categories). After 2007, the categories were as follows: (1) Persons in charge of party and mass organizations of state organs, enterprises, and public institutions. (2) Professional and technical personnel. (3) Clerical and related personnel. (4) Commercial and service personnel, including sales, procurement, supply and marketing, acquisition, and other commercial and service personnel. (5) Personnel in agriculture, forestry, animal husbandry, fishing, and water conservancy. (6) Operators and related personnel of production and transportation equipment: section heads and various production workers, equipment operators, drivers, sailors, other production and transportation workers, and related personnel. (7) Soldiers. (8) Other practitioners who are difficult to classify (refers to persons not in the preceding seven categories).

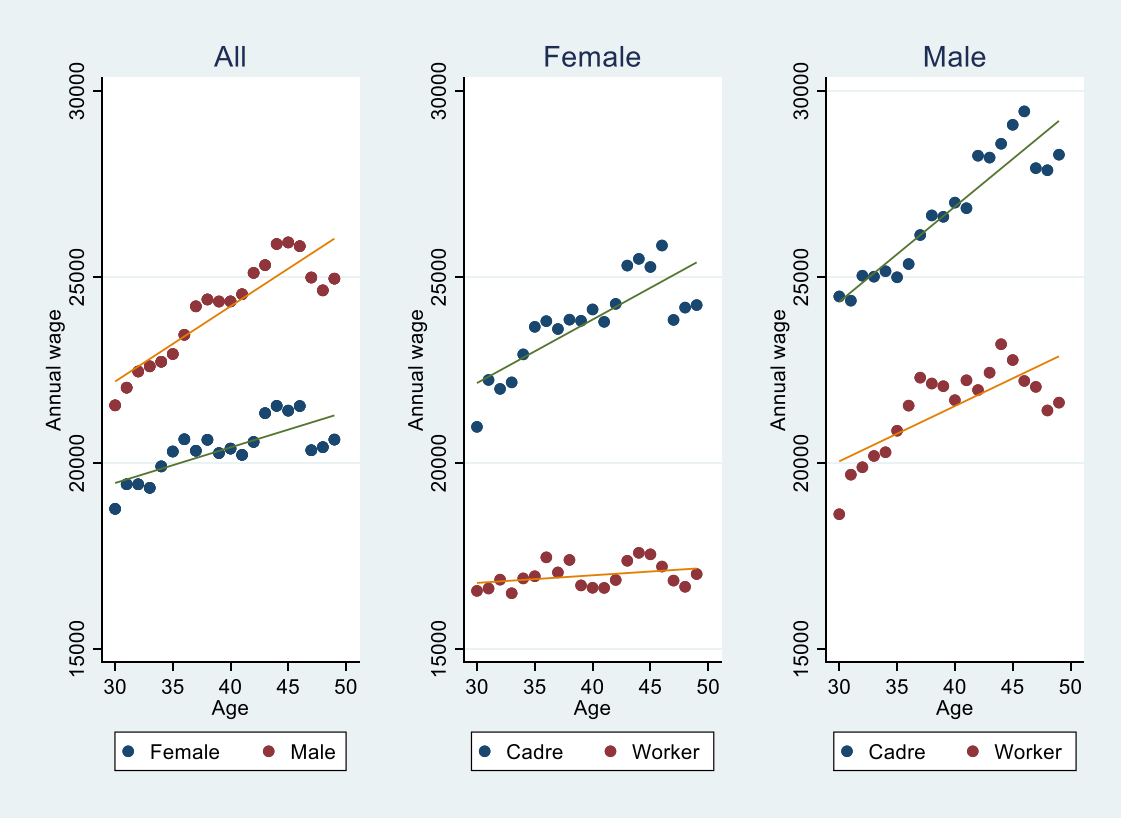

Fig. 1. Age–wage (mean value) for female and male cadres and workers. Data Source: UHS.

cadres earned approximately 40 % more than female workers. Male cadres had the highest wages, followed by female cadres, and female workers had the lowest wages. The samples' average working time in the previous month was approximately 175.2 h. Men worked slightly more than women, averaging approximately 3–4 h more per month. The working hours of workers were slightly longer than those of cadres, but the difference was not significant, and the hourly wages of cadres were higher than those of workers.

The average educational level of men was higher than that of women, and the educational level of cadres was higher than that of workers. Female workers had the lowest education level, and male cadres had the highest education level. Approximately 38.5 % of male cadres had a college education or above; approximately 35.5 % had a tertiary education, approximately 21.2 % had a high school or technical secondary school education, and approximately 4.8 % had an education level below junior high school. Only 40.6 % of male workers had tertiary education or above, substantially lower than the rate (74 %) for male cadres. Women exhibited a similar trend. Approximately 69.9 % of female cadres had a tertiary education or above, approximately 26.9 % had a high school or technical secondary education, and only approximately 3.1 % had an education level below junior high school. Approximately 64.9 % of female workers had an education level of high school, technical secondary school, or below, and only approximately 35 % had a tertiary education or above. Evidently, education is a crucial factor determining whether individuals become cadres or workers.

Fig. 1 presents the wage difference between cadres and workers for specific genders at each age. On average, individual wages increased with age, and the gender wage gap also increased with age. Men earned higher wages than women, and the wage growth rates with age for men were also higher than those for women, resulting in a "scissor gap" shape with as age increased. This study further differentiated between workers and cadres of different genders; the wage growth of female workers and cadres exhibited a more pronounced "scissors gap" pattern. Although the wages of male cadres were slightly higher than those of female cadres, the wage growth rate for male workers was significantly higher than that for female workers. Consequently, the wage differential attributable to age was more substantial for female cadres and workers than for men. Given that female workers and cadres retire at age 50 and 55 years, respectively, the closer to the retirement age a worker was, the more significant was the wage difference between the female cadres and workers. However, the change in wage difference between male workers and cadres was somewhat smaller than that of female workers and cadres.

Table 2
Triple interaction regression results for wage differences.

Variables	(1) OLS	(2) OLS	(3) OLS
Female × Worker × Age	-0.0055***	-0.0071***	-0.0079***
	(0.0016)	(0.0015)	(0.0013)
Female	-0.0978***	-0.0919***	-0.1110***
	(0.0133)	(0.0132)	(0.0119)
Worker	-0.1992***	-0.0755***	-0.0453***
	(0.0168)	(0.0147)	(0.0121)
Age	0.0089***	0.0137***	0.0129***
	(0.0011)	(0.0013)	(0.0008)
Female*Worker	-0.0955***	-0.0688***	-0.0619***
	(0.0186)	(0.0177)	(0.0161)
Female*Age	-0.0023*	-0.0006	0.0007
	(0.0012)	(0.0012)	(0.0010)
Worker*Age	-0.0019	0.0010	-0.0025**
	(0.0013)	(0.0012)	(0.0010)
Year Dummies	Y	Y	Y
Personal Characters		Y	Y
Regional variables			Y
Constant	9.5666***	8.2503***	8.3999
	(0.0286)	(0.0574)	(6.8566)
Observations	148,949	148,949	148,949
R-squared	0.1994	0.2896	0.4142

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. Personal character variables included marriage status (married equals 1), education level, number of children aged 0–6 years in the family, and dummy variables of industry. Regional variables included city-level character variables, city dummies, and the intersection of city dummies and year dummies. The city-level variables includes GDP per capita with consumer price index adjustments (logarithmic form), GDP growth rate, the structure of industries in the city, labor force participation rate, and unemployment rate. Robust standard errors were used in regressions, and all regressions were clustered at the city level.

5. Empirical results

5.1. Basic analysis: triple difference regression

Because only women in different employment positions had varying retirement ages, the policy should only affect women and not men. Triple difference regression analyses were performed in this study. In Columns 1–3 of Table 2, the explained variable was logarithmic wage, and the vital explanatory variables included the dummy variables of women and workers, a continuous variable of age, and the interaction terms of the three variables. The age variable here was the actual age minus 30 years; that is, the value of the age variable in the regression was 0–19 years (referring to 30–49 years). To address possible confounders in the regression, observable individual characteristics and city-level variables were controlled for step by step from Columns 1–3.

All coefficients of the triple interaction terms in Columns 1–3 were significant and negative. This result indicates that over 1-year age increases, the wage differences between female workers and cadres were significantly greater than those between male workers and cadres, and the gender wage differences between workers were greater than those between cadres. The results in Column (3) indicate that the wage differences between female workers and cadres for each year of age were an average of 0.79 % higher than that between male workers and cadres. As age increased, the wage growth rate difference between workers and cadres was 1.04 % for women and 0.25 % for men. The wage gap between workers and cadres was approximately 10.7 % for women and 4.53 % for men at age 30 years, and it increased to 30.46 % for women and 9.28 % for men at age 49 years. From age 30–49 years, the wage difference between workers and cadres was approximately 15 % (19 × 0.79 %) higher for women than for men.

The coefficients of other variables were combined for analysis. Women's wages were significantly lower than men's, and workers' wages were significantly lower than those of cadres. The wage growth of each group, whether for cadres, workers, women, or men, varied by different degrees of magnitude, resulting in wage gap expansion. The gender wage gap of workers increased with age, whereas that of cadres did not change significantly. Specifically, for each additional year, the wage growth rate was approximately 1.29 % for male cadres and similar for female cadres. By contrast, the wage growth rate was approximately 1.04 % for male workers and only 0.25 % for female workers. The gender wage gap for cadres was approximately 11.1 % at age 30 (age variable = 0) and did not exhibit significant change at age 49 as the coefficient of the intersection of the female and age variables was nonsignificant; by contrast, the gender wage gap for workers was approximately 17.29 % at age 30 years and was approximately 32.2 % at age 49 years, exhibiting a "scissor gap" and thereby supporting the research hypothesis.

In general, the wage growth rate of female workers was much lower than that of other groups, and the wage growth difference between female workers and cadres was much greater than that of men. After control for multiple possible confounders, including individual characteristics and regional variables, the researchers determined that such differences were likely to have been caused by gender differences at retirement age.

Table 3
2SLS estimation for the triple interaction regression.

Dependent Variables	(1) First Stage Worker	(2) 2SLS Wage
IV	-0.0105*** (0.0001)	
Female × Worker × Age		-0.0178*** (0.0024)
Control variables	Y	Y
Observations	148,949	148,949
R-squared		0.3846
Under-identification test (LM statistic)		8642.873
Weak identification test (Wald F statistic)		3002.213
Overidentification test (Hansen J statistic)		0.329

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. The control variables included all the personal characteristics and regional variables, as presented in Table 2. Robust standard errors were used in regressions, and all regressions were clustered at the city level.

Table 4
Triple interaction regression results for wage differences, with age as a dummy variable.

Variables	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS
Female × Worker × Age Dummy	-0.0499*** (0.0164)	-0.0674*** (0.0155)	-0.0788*** (0.0137)	-0.1620*** (0.0251)
Other dummies	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y
Personal Characters		Y	Y	Y
Regional variables			Y	Y
Observations	148,949	148,949	148,949	148,949
R-squared	0.1984	0.2866	0.4122	0.3844
Under-identification test (LM statistic)				8618.264
Weak identification test (Wald F statistic)				3002.185
Overidentification test (Hansen J statistic)				0.330

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. The control variables included all the personal characteristics and regional variables, as presented in Table 2. Robust standard errors were used in regressions, and all regressions were clustered at the city level. The chi-squared P value for the LM statistic was 0.000. The chi-squared P value for the overidentification test was 0.5664. In all the tests for IVs, namely the under-identification test (LM statistic), weak identification test (Wald F statistic) and overidentification test (of all instruments), the results were adequate.

5.2. Robustness assessment

5.2.1. Using IVs to overcome possible endogeneity problems

A problem with the aforementioned analysis is that the employment positions were not randomly assigned. The selection between cadres and workers was affected by numerous factors, including personal characteristics, macroeconomic background, and regional economic development. Although the observable characteristics in the equation were controlled, including personal characteristics, city-level characteristics, city dummies, and the cross-section of city dummies with year dummies, unobserved confounders may still have affected the results.

The IV method can address these challenges; therefore, 2SLS regression was used to test the robustness of the results in which the primary instrumental variable was the proportion of cadres in a city. After control for relevant variables at the city level, the proportion of regional cadres was expected to affect the probability of individuals becoming cadres, but it was not related to the missing variables in the wage equation affecting productivity. The cross terms of the proportion of regional cadres with other variables served as the IV group for the triple difference regression. The estimation results of the first stage regression and the 2SLS estimation are presented in Table 3. All tests regarding the exclusion and correlation condition of IVs have been evaluated, and they demonstrated the validity of the IVs.

The regression results for the selection equation in the first stage are presented in Column 1 of Table 3. An increase in the proportion of cadres in a region (i.e., instrumental variable) may considerably reduce the probability of an individual becoming a worker. With the IV group used to conduct a triple interaction term analysis, the results are presented in Column 2 in Table 3. The chi-squared P value for the LM statistic was 0.000. The chi-squared P value for the over-identification test was 0.566. The IVs passed all the tests namely, the under-identification test (LM statistic), weak identification test (Wald F statistic) and over-identification test (for all instruments). The regression results demonstrate that the gender gap in wage difference between workers and cadres continued to increase with age, and the basic conclusion has not changed. The IV estimation supports the robustness of the research regression.

Table 5
Evaluation of bias caused by unobservable factors.

Control Variables	Coefficient Difference			
	Continuous age variable	Dummy age variable	Continuous age variable and predicted Worker	Dummy age variable and predicted Worker
None	3.29	2.73	7.74	7.26
Personal characters	9.88	6.91	89.00	13.85
City-level variables	4.39	3.08	10.47	14.59
Personal characters & City-level variables	26.33	9.27	178.00	90.00

Notes: Each cell of the table reports ratios based on the coefficient for female × worker × age from individual-level regressions.

Table 6
Regression results for different enterprise types.

Variables	(1) Urban collective economic units	(2) Joint, joint-stock, and foreign-funded enterprises	(3) Urban individual and private enterprises
Female × Worker × Age	-0.0027	-0.0073*	0.0006
	(0.0056)	(0.0042)	(0.0063)
Control variables	Y	Y	Y
Observations	16,766	30,704	26,838
R-squared	0.4061	0.4372	0.3739

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. The control variables included all the personal characteristics and regional variables, as presented in Table 2. Robust standard errors were used in regressions, and all regressions were clustered at the city level.

5.2.2. *Use of an age dummy variable*

As indicated in Table 4, an age dummy variable (1 for age 41–49 years and 0 otherwise) was applied to demonstrate the robustness of the results. The results indicate that the dummy variable did not affect the main conclusion. The coefficient of the age dummy variable in Column 3 demonstrates that the wage difference between female workers and cadres was 7.88 % higher than that between male workers and cadres (for those aged 41–49 years compared with those aged 30–40 years). The results indicate that the wage difference between female workers and cadres was 11.78 % for those aged 30–40 years and increased to 21.37 % for those aged 41–49 years. The wage difference between male workers and cadres was 9.03 % for those aged 30–40 years and increased to 11.53 % for those aged 41–49 years. Although wage differences between cadres and workers of both sexes exhibited a "scissors gap" pattern, changes in the wage gap between cadres and workers for women were far greater for women than for men. The estimated results of the instrumental variable regression also demonstrated the results' robustness.

5.2.3. *Evaluation of bias caused by unobservable factors*

To measure the potential sample selection effect, the methods of Altonji et al. (2005), and Nunn and Wantchekon (2011) were applied. Four groups of restricted control variables were considered: the first group had no other control variables, the second group included personal characteristics, the third group included city-level characteristics, and the fourth group included personal characteristics and city-level characteristics. Four sets of full control variables were also considered. The age variable was used for the continuous and dummy variables, and the worker variable was used for the original and predicted values (2SLS). The coefficients of full control variables are reported in Tables 2–4. Therefore, 16 combinations of restricted and unrestricted variables were obtained. The sample sizes were the same in all regressions, and year-fixed effects were included.

The results indicate that none of the 16 ratios were below 1, with the ratio values ranging from 2.73 to 178; the median ratio was 9.27. Therefore, to attribute the entire OLS estimate to the self-selection effect, the self-selection value based on unobservable factors must be at least 2.73 and, on average, over nine times greater than the self-selection value based on observable factors. Thus, these results suggest that the estimated coefficient of the triple interaction term was unlikely to be entirely the result of unobservable factors or sample selection effects (Table 5).

5.2.4. *Analysis of private and individual enterprises*

Different companies apply different levels of policy implementation. According to policy documents, state-owned economic units, foreign enterprises, joint-stock enterprises, and other formal enterprises comprehensively implement policies, whereas private and individual enterprises may not be strictly constrained by such policies. Therefore, if the enterprises that strictly implement policy demonstrate a more substantial policy effect than those that do not, the conclusion's robustness can be verified. To test this hypothesis, different enterprise types, which were not included in our previous regression samples, were analyzed through regression. The regression results in Table 6 demonstrate that the coefficient of the triple interaction term in joint, joint-stock, and foreign-funded enterprises were significant, whereas the coefficient of urban collective economic units and individual and private enterprises were nonsignificant. This finding supports the study hypothesis.

Table 7
Regression results for different education levels.

Variables	(1) OLS	(2)	(3) 2SLS	(4)
	High Education	Low Education	High Education	Low Education
Female × Worker × Age	-0.0070***	-0.0137**	-0.0173***	-0.0369**
	(0.0014)	(0.0068)	(0.0027)	(0.0153)
Control variables	Y	Y	Y	Y
Observations	128,096	20,853	128,096	20,853
R-squared	0.4049	0.3350	0.3827	0.3296
Under-identification test (LM statistic)			7798.391	334.5
Weak identification test (Wald F statistic)			2289.050	214.41
Overidentification test (Hansen J statistic)			0.754	0.247

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. The control variables included all the personal characteristics and regional variables, as presented in Table 2. Robust standard errors were used in regressions, and all regressions were clustered at the city level. For all the tests for IVs, namely the underidentification test (LM statistic), weak identification test (Wald F statistic), and overidentification test (for all instruments), the results were adequate.

Table 8
Regression results for non-gender-biased and other industries.

Variables	(1) OLS	(2)	(3) 2SLS	(4)
	Non-gender-biased	Other industries	Non-gender-biased	Other industries
Female × Worker × Age	-0.0082***	-0.0074***	-0.0270***	-0.0158***
	(0.0027)	(0.0015)	(0.0055)	(0.0027)
Control variables	Y	Y	Y	Y
Observations	31,870	117,079	31,870	117,079
R-squared	0.4147	0.4177	0.3866	0.3898
Under-identification test (LM statistic)			1606.573	6919.968
Weak identification test (Wald F statistic)			495.813	2455.727
Overidentification test (Hansen J statistic)			0.734	0.098

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. The control variables included all the personal characteristics and regional variables, as presented in Table 2. Robust standard errors were used in regressions, and all regressions were clustered at the city level. For all tests for IVs, namely the underidentification test (LM statistic), weak identification test (Wald F statistic), and over-identification test (for all instruments), the results were adequate.

5.2.5. Regression results for different education levels

The descriptive statistics detailed in Table 1 demonstrate that employees with low education levels were likely to be workers. Approximately 90 % of those with education below junior high school were workers. Individuals with lower education levels may have unobservable characteristics that differ from those of other groups. To render the two groups of cadres and workers more comparable, the samples were separated according to education level to verify the robustness of the results. Table 7 demonstrates that for the group with high education levels (high school education or above), the wage difference between female workers and cadres increased was 0.7 % higher for each additional year of age than that between male workers and cadres. Compared with the regression results in Table 2, the regression results for high education samples reported in Table 7 were slightly lower but remained significant. The regression results for participants with a low education level (junior high school and below) indicate that the retirement policy had a significantly greater effect on this group than on the high education group. This result confirms the study hypothesis, and the significant results after sample differentiation and 2SLS regression also demonstrate the robustness of the results.

5.2.6. Analysis of non-gender-biased industries

Occupational gender segregation may result in unbalanced gender distribution in different industries, and the excessive concentration of men or women in some industries may lead to gender differences in employment opportunities and career development. Some non-gender-biased industries were selected for investigation to verify the study conclusion in accordance with the gender proportion of the age-appropriate population in different industries, as per UHS data. Industries with a gender ratio between 45 % and 55 % were selected for analysis. In the UHS data, wholesale and retail trade, the catering industry, the finance and insurance industries, the real estate industries, the education industry, the entertainment industry, national party employment, government organs, and social organizations had relatively balanced gender ratios. As presented in Table 8, the coefficients of the triple interaction term in non-gender-biased and other industries were significant. That is, the age–gender wage gap may not be entirely derived from the effects of unobserved variables. In non-gender-biased industries, compared with male workers and cadres, the average wage difference between female workers and cadres was 0.82 % higher for every 1-year increase in age.

Table 9
Triple regression results for working hours and estimated wage rates.

Dependent Variables	(1) Working time	(2) Wage rate	(3) Wage	(4) Wage	(5) Wage
Female × Worker × Age	-0.0014*	-0.0068***	-0.0082***	-0.0081***	0.0027***
	(0.0008)	(0.0024)	(0.0015)	(0.0015)	(0.0009)
Working hours in previous month (logarithm)				0.0676***	
				(0.0080)	
Wage rate (logarithm)					0.8098***
					(0.0312)
Control variables	Y	Y	Y	Y	Y
Observations	76,893	76,893	76,925	76,893	76,893
R-squared	0.2465	0.3436	0.3576	0.3584	0.8692

Notes: *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$. The control variables included all the personal characteristics and regional variables, as presented in Table 2. Robust standard errors were used in regressions, and all regressions were clustered at the city level.

Table 10
Triple regression results for career promotion, job changes, and on-the-job training.

Dependent Variables	(1) Career promotion	(2) Job change	(3) On-the-job training
Female × Worker × Age	−0.0279*	−0.0036*	0.0003
	(0.0153)	(0.0021)	(0.0018)
Control variables	Y	Y	Y
Observations	14,279	14,279	14,279
R-squared	0.6881	0.0403	0.0539

Notes: All regressions control for the individual characteristic variables, region, and years. Standard errors clustered at the individual level are reported in parentheses. *** represents $p < 0.01$, ** represents $p < 0.05$, and * represents $p < 0.1$.

Table A1
Descriptive analysis of Chinese General Social Survey data.

Variables	Males		Females	
	Workers	Cadres	Workers	Cadres
Sample size	5156	3491	6034	1837
Current age	50.476	51.117	50.955	50.749
Variables within the life cycle:				
Age	37.649	38.860	37.842	38.472
Work experience	14.094	11.741	13.938	12.677
Married	0.969	0.978	0.984	0.979
Education level	4.144	6.113	3.874	5.419
Type of employment unit:				
Party and government organs	0.042	0.123	0.023	0.050
Enterprises	0.778	0.597	0.822	0.620
Public institutions	0.180	0.280	0.155	0.331
Ownership of employment unit:				
State-owned or state-controlled	0.702	0.871	0.677	0.741
Collective or collective holding	0.196	0.081	0.228	0.198
Private	0.103	0.048	0.095	0.061

5.2.7. Analysis of possible influence channels

The aforementioned analyses demonstrate that the retirement age policy significantly affected gender differences in pay. This significant effect may occur through multiple channels. From the perspective of employees, their work motivation may be reduced as they approach retirement, thereby reducing work input and human capital investment. From the perspective of enterprises, they may offer only limited opportunities for on-the-job training and promotion to employees approaching retirement. Employee behavior changes may affect enterprise decisions on promotion and training. Consequently, the discriminatory behavior of enterprises may further affect employees' participation and attention to work. The following section details the potential influence channels of the retirement age policy through a discussion of employees' labor participation.

5.3. Possible channels

5.3.1. Working hours and wage rates

Individual working hours and pay rates affect their wages. By using the working hours of individuals in the previous month (per

UHS data) and estimated wage rates[2] (i.e., reported wages divided by working hours in the previous month) as the explained variable, a triple interaction term regression was performed (Table 9).

The results indicated that the closer to retirement age female workers were, the greater was the gap in wage rates between women and men. For every 1-year increase in age, the gender difference in the working hours of workers and cadres increased by 0.14 %. The average working hours in the previous month in the samples was approximately 175.2 h, and the annual working time was 2102.4 h (assuming employees worked for 12 months annually). Combined with the regression result, the difference in working time between female and male workers was 2.94 h more than that between female and male cadres for a 1-year increase in age. The decrease in working hours may be one reason for the increase in wage differences. The result in Column 2 of Table 9 demonstrates that the gender wage rate difference between workers and cadres increased by 0.68 % with a 1-year increase in age. Given that individual characteristics were controlled, the difference in the returns of employees of different genders in various employment positions indicates that enterprises may discriminate against low-wage groups. When employees' working hours in the previous month and estimate wage rates were factored into the relevant equation, with wage used as the explanatory variable, the results indicated that the triple interaction term coefficient decreased slightly after their labor time was added and decreased after the wage rate was added. This result suggests that individual labor time and wage rate may be the reasons for the increase in the gender wage gap, particularly the wage rate.

5.3.2. Career promotion, job changes, and on-the-job training

Given that the UHS data did not provide information on individual career promotion, the China General Social Survey (CGSS) of 2008 was used for supplementary data analysis; it provides detailed information on individual education and job changes. This project is a nationwide large-scale sample survey conducted by the Renmin University of China Department of Sociology. CGSS was conducted from October to December 2008, covering 6000 urban and rural samples in 28 provinces, autonomous regions, and municipalities directly under the central government, including 125 counties (districts), 500 subdistricts and towns, and approximately 1000 resident and village committees. Samples in urban areas between the age of 40 and 60 in 2008 were retained, and information on individuals' work between 30 and 49 years old was reviewed. Information on individuals' work life, including employment status, job characteristics (workers or cadres), working unit, industry, career promotion (including general workers or clerks, technicians, grass-roots cadres, mid-level cadres, heads of units), education, marital status, work experience, and other essential information were obtained. Accordingly, this information formed panel data at the individual level for people of different ages. Those who had not worked or who had worked in enterprises or institutions were excluded.

The final sample included 1173 individuals and 16,518 panel data samples, with each individual's average work life spanning 14 years. Women accounted for 47.65 % of the total samples. According to the questionnaire, those with tertiary education or above; those who worked for the Chinese Communist Party, government organizations, enterprises, or institutions; and those in charge of units were regarded as cadres, whereas others were regarded as workers. In total, cadres accounted for 16.3 % of the total sample and 23.13 % and 9.26 % of the male and female subsamples, respectively. The regression results are presented in Table 10. The explained variables were number of promotions, job changes, and on-the-job training.

Higher positions are associated with higher salaries, and differences in managerial positions may be key reasons for the gender wage difference. Job mobility is one of the major factors affecting wage growth after labor market entry (Topel & Ward, 1992). Women are less mobile than men, which may result in women having lower wages compared with men (Manning & Swaffield, 2008). The results in Table 10 demonstrate that the coefficients of the triple interaction terms were significantly negative for job promotion and the number of job changes, thereby indicating that the retirement age policy may affect wages by impeding career promotion and lowering the possibility of job change. Consequently, a significant result was not obtained because on-the-job training samples accounted for a low proportion of the total samples.

6. Conclusions and policy implications

This study analyzed the effects of gender-differentiated retirement age on the gender wage gap and the possible influencing channels. We observed some noteworthy results based on data from 16 provinces of China from 2002 to 2009. Generally, for each 1-year increase in age, the wage difference between female workers and cadres was 0.79 % higher than that between male workers and cadres, presenting a "scissor gap." From age 30–49 years, the wage difference between female workers and cadres increased by approximately 15 % more than that between male workers and cadres. Such differences were likely caused by gender differences in retirement age. After control for multiple influencing factors, such as individual characteristics and regional variables using IVs and subsample analysis, we demonstrated that our findings were robust. The gender difference between workers and cadres in working hours, wage rate, career promotion, and job change activity as they approach retirement may influence the extent to which retirement age policy affects wage differentials.

Our findings demonstrate that reducing or eliminating the retirement age difference may reduce wage differences. Given the rate of population aging in China, the retirement age policy should be reformed. Delaying the retirement age alleviates the adverse effects of population aging on labor supply and pension fund balances. The 14th Five-Year Plan (2021–2025) for National Economic and Social Development proposed raising the legal retirement age gradually. The retirement age of Chinese women is 10–15 years lower than that

[2] The survey findings on labor income and working hours did not match in the questionnaire, and the results of estimating hourly wage rate were not precise. Additionally, information on working hours was only available from 2003 to 2006.

of many other countries. Hence, initial reforms may include delaying women's retirement age, particularly that of female workers. Given that women typically live approximately 5 years longer than men on average, increasing the female retirement age would substantially affect the pension fund balance.

A non-gender-biased retirement age policy should be adopted. For women, this policy may eliminate the adverse effects of their retirement age in the labor market by encouraging them to invest in human capital, and it may motivate enterprises to afford women equal opportunities and maximize the human capital of the female labor force. A non-gender-biased retirement age policy has been adopted by numerous countries; such a policy is conducive to women's development and contributes to the fairness and competitiveness of the labor market.

A flexible retirement age policy could be adopted. A flexible retirement age policy entails a minimum age for pension eligibility, and the actual retirement age can be determined by labor market supply and demand. The policy could also be non-gender-biased, but the choice may be markedly more important for women than for men. Inevitably, women could bear additional care responsibilities in the division of housework, and a flexible retirement age policy would enable them to make choices between the labor market and family according to their individual needs.

Declaration of Competing Interest

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

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Appendix

(See here Appendix Table A1).

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