

Reward and Punishment Mechanisms of the Flexible Retirement System in China

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Abstract

This article attempts to understand the reward and punishment mechanisms of the flexible retirement system in China. The life-cycle model is applied in the pay-as-you-go pension system with flexible retirement policy to establish the numerical model of optimal retirement age under the consideration of prolonged life span. The effect of penalty rate for early retirement and incentive rate for delayed retirement on optimal retirement age is studied. Numerical experiments show that appropriate delayed retirement incentive rate incentivises a delayed retirement decision for maximising the total lifetime utility. The optimal retirement age is raised by prolonging lifespan, and the flexible retirement system is an effective means to implement delayed retirement policy.

Keywords

Flexible Retirement System, Delayed Retirement, Life-Cycle Theory, Optimal Retirement Age

1. Introduction

According to China's current retirement system, males retire at the age of 60, whereas females retire at 55. As the retirement system is deeply rooted in public, if the retirement age is suddenly extended, public discontent may inevitably occur. Flexible retirement system allows workers to have flexibility in retirement age, patterns and income. Reward and punishment mechanisms will affect people's retirement options. For example, in Germany, early retirement for a year will lead to a 3.6% pension reduction, whereas delayed retirement for one year will result in a 6% increase (Lin, 2013). In the United States, pensions for early retirement workers will be reduced by 0.56% per month in advance, and if one year is delayed, the pension will increase by 3% and is likely to increase to

8% in 2022. Staffs who retire at the age of 70 can take 40% more of the pension than those who retire at 65. Pension will be reduced by 6.2% per year for those who retire lower than the legal age (Zheng & Liu, 2011). The state studies the establishment of flexible retirement system on the basis of a clear minimum retirement age, which can serve as a buffer policy to allow willing individuals to retire first, extend the policy concept of delayed retirement in society and advance comprehensively progressive delayed retirement system. This article attempts to understand rewards and punishment mechanism of flexible retirement system in China. The overview of the research on flexible retirement system is provided in the second part of the paper. The life-cycle model applied in the pay-as-you-go pension system with flexible retirement policy is used. The method, including basic assumptions consistent with institutional logic and mathematical modelling, are introduced in the third part. The results are provided in the fourth part, followed by the conclusion in the last part.

2. Literature Review on Flexible Retirement

In foreign developed countries, income and retirement age adjustment constitute a flexible retirement system, allowing workers to retire at the minimum retirement by increasing pension to encourage delayed retirement and improve the participation rate of older workers. At the same time, appropriate penalties are implemented for early retirement to inhibit this behaviour and ease the financial pressure of government pension system, ensuring the sustainable development of pension insurance system (Lin & Xia, 2011).

The life-cycle model (Ando & Modigliani, 1963) and its extended model (Kalemli-Ozcan & Weil, 2010; Deng & Wang, 2008) in historical documents show that individual pension is an incomplete accumulation system. Considering that the basic pension in China's retirement pension system is pay as you go, which differs from the systems in previous research, the life-cycle model established in the present paper takes into account the pay-as-you-go retirement pension income of retired persons under the flexible retirement system. That is, by paying the retirement pension, individuals receive pension according to a certain proportion of the pre-retirement salary in the future, which has not been considered in historical documents. Retirement age options of individuals will determine pension income after retirement, and the increase in life expectancy is considered.

The study on the pros and cons of flexible retirement system abroad include the following. Simonovits found that flexible retirement system makes workers with higher welfare expect to obtain better retirement benefits than those with lower welfare, thereby improving the total social welfare, which is more efficient than the fixed retirement age system (Simonovits, 2006). Börsch-Supan and Schnabel's research on the German pension system shows that flexible retirement system plays a positive incentive role in raising retirement age in the context of ageing population (Börsch-Supan & Schnabel, 1998). Cliff's empirical

study on workers' retirement behaviour in the chemical industry in the UK suggests that deferred retirement bonus benefit has an incentive effect on the late retirement decisions of healthy and seasoned workers and that deferred retirement will improve the life quality of delayed retirement workers (Cliff, 1991). Eso and Simonovits studied flexible retirement age system with the theory of mechanism design, assuming that individuals have personal information with different life expectancies by using the constant relative risk aversion utility function, which proves that flexible retirement system is an optimal mechanism under the condition that individual utility function is a strictly concave mechanism (Eso & Simonovits, 2002). The research of Eso, Simonovits and Toth indicates that under the condition that the government only obtains information of average life expectancy, flexible retirement system motivates individuals with long life expectancy to choose deferred retirement and ensures the early retirement demand of individuals with short life expectancy as well as fairness and harmony of the social system (Eso & Toth, 2011). Kalemli-Ozcan and Weil applied life-cycle theory to study individual retirement behaviour wherein life expectancy increases and mortality rate is reduced. They found that optimal retirement age is an increasing function of life expectancy (Kalemli-Ozcan & Weil, 2010).

In China, the benefits of flexible retirement system have also been discussed. Economic and sociological perspectives on flexible retirement system proposed by Li and Tang discuss that flexible retirement system is an organic supplement to China's retirement pension system, and it guarantees impartiality of the early retirement of disadvantaged groups and motivates deferred retirement of abler people (Li & Tang, 2004). Deng Jiguang's research on the flexible retirement system implemented in Shanghai as the pilot city shows that flexible retirement system helps relieve Shanghai's ageing population, makes full use of human resources and slows down pension burden (Deng, 2010). The quantitative analysis made by Yang, Zhang Fangfang and Zhang Jie proves that flexible retirement policy exerts a stimulating influence on deferred retirement, alleviates the pension burden and exerts a smoothness effect on labour supply and demand (Yang, Zhang, & Zhang, 2010). Deng Dasong and Wang studied the optimal retirement age under the condition of declining population mortality by establishing the life-cycle theory model and pointed out that early retirement is the main reason for the imbalanced income and expenditure of China's basic pension (Deng & Wang, 2008).

In this paper, the logarithmic utility function is used to express the total utility of personal life cycle, and pension contribution rate and pension substitution rate are parameterised. In addition, delayed retirement reward rate and early retirement penalty rate are introduced. The individual optimal retirement age decision is calculated by numerical experiments. The option of individual optimal retirement age in flexible retirement system is analysed under the condition that the life expectancy is increased. The influence of other economic parameters on

the optimal retirement age is also analysed.

3. Research Method

3.1. Basic Assumptions Consistent with Institutional Logic

Experts suggested that flexible delayed retirement for women cadres can be implemented first before the progressive delay in retirement age. Considering that flexible retirement system allows individuals to retire before reaching the legal retirement age or choose to prolong retirement, if early retirement will be subject to a reduction in pension penalties, and if delayed retirement can be rewarded with an increased pension, then the model in this section is based on the following assumptions:

- 1) Leisure life is non-existent during work (except holidays); leisure occurs only during retirement.
- 2) The increase of effectiveness in leisure life during retirement is fixed.
- 3) The statutory retirement age is 60.
- 4) Pension insurance is paid by pension payment rate during work, and pension is received in accordance with the pension replacement rate after retirement.
- 5) Individuals who retire before the statutory retirement age will be punished by reducing the pension replacement rate.
- 6) Individuals who retire after the statutory retirement age will be rewarded by increasing the pension replacement rate.
- 7) The discounted value of the total consumption in the personal life cycle is equal to the discounted value of labour income and pension income during work.

Figure 1 illustrates the personal life cycle in the flexible retirement system.

As shown in **Figure 1**, “ S ” refers to “age of work”, when the pension is started to be paid, and “ $S-N$ ” stands for the pension payment during work. “ M ” is the “legal retirement age”, individuals who retire before the statutory retirement age will get pension decrease, that is “ $N-M$ ”. Those who retire after the statutory retirement age will get pension increase.

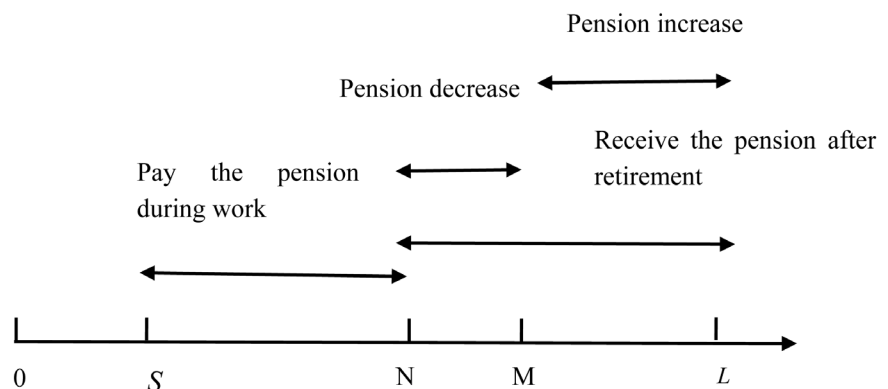


Figure 1. Personal life cycle in the flexible retirement system.

3.2. Mathematical Modelling

Based on the framework of the life-cycle model established by Kalemli-Ozcan & Weil (2010), part of the income of the retired elderly is considered the base pension of the pay-as-you-go system and the penalty rate for early retirement and incentive rate for delayed retirement vary across different retirement ages in the flexible retirement system. The life-cycle model is established under the condition that per-capita life expectancy is increasing, and the following are the parameter variable hypothesis:

S : age of work, D : age of death, R : retirement age,

M : legal retirement age, w : initial wage, β : wage growth rate,

k : pension replacement rate, μ : penalty rate for early retirement, ν : incentive rate for delayed retirement,

λ : pension contribution rate, r : interest rate, θ : personal utility time preference coefficient,

l : leisure utility of post-retirement, $C(t)$: personal t -year-old consumption plan.

In this paper, the logarithmic function is used as the utility function, and in the case of individual death age, the total utility expectancy function of the individual life cycle is determined using the equation below:

$$U = \int_0^D e^{-\theta t} \ln(C(t)) dt + \int_R^D e^{-\theta t} l dt \quad (1)$$

Taking into account the budget limits of the individual life cycle, the personal life cycle income is divided into two parts. One part is the income during work and the other is the retirement pension income, which is equal to the total consumption of personal life cycle. Owing to the flexible retirement system, individual choice of retirement time will affect work income and pension replacement rate after retirement, resulting in the following function:

$$\begin{aligned} & \int_0^R e^{-(r-\beta)t} (1-\lambda) w dt + \int_R^D e^{-rt} (k + \min(R-M, 0)\mu + \max(R-M, 0)\nu) w dt \\ & = \int_0^D e^{-rt} C(t) dt \end{aligned} \quad (2)$$

In the above formula, $\min(R-M, 0)\mu$ represents the reductive ratio of pension substitutes for early retirement. In the case of delayed retirement, $\max(R-M, 0)\nu$ is used to represent increased pension replace rate. Assuming that the individual assets during the work period cannot be negative, the following restrictions are obtained:

$$\int_0^{\min(R,z)} e^{-rt} (1-\lambda) w dt - \int_0^z e^{-rt} C(t) dt \geq 0 \quad (3)$$

The Hamiltonian function is constructed by Formulas (2), (3) and (4), and the first-order condition of the individual optimal consumption function $C(t)$ is obtained as

$$C'(t) = (r - \theta)C(t). \quad (4)$$

The individual optimal consumption function $C(t)$ is easily obtained by the following differential equation:

$$C(t) = e^{(r-\theta)t} C_0. \quad (5)$$

Formula (2) is a piece-wise function, thus acquiring initial consumption with this formula is difficult. This paper uses numerical test method to solve and acquire the total utility of individual life cycle of different retirement ages, and from which finds the optimal retirement age to maximise its effectiveness.

4. Result and Discussion

The numerical experiments in this paper are based on the data of the retirement pension payment rate and retirement pension under the current retirement pension system in China. Numerical experiments are made for optimal retirement age based on the previous calculation of Formulas (2) and (5). The consumption and storage total value are calculated based on personal life cycle, and the balance between consumption and storage of personal life cycle is compared. According to the Sixth National Population Census of the People's Republic of China, the average life expectancy is 73.76 years. The average life expectancy is estimated to be 75.61 years in 2020. The average life expectancy that this paper adopts is 75 years.

In 2014, the Peking University Joint Job Application Website conducted a survey for 350,000 documents on the starting salary of the post-90 generation. The statistics shows that the average starting salary of fresh graduates was 2443 yuan/month in 2014. Considering the graduate employment rate in China is around 80%, the starting salary is adjusted to 2000 yuan/year. China's economic growth, risk-free interest and inflation rates are fully considered in the salary growth rate adopted. Considering the benchmark risk interest rate in China was 4.6% in 2014, the salary growth rate is estimated to be 2.13%. As the retirement pension in this paper only considers the basic retirement pension of social pooling, the personal account retirement pension is considered as the savings in the individual's life cycle. Income after retirement only takes the basic retirement pension into account for the convenience of calculation. According to the pay-as-you-go social pooling retirement pension payment rate, enterprises pay 20% of the retirement pension payment rate. According to the basic retirement replacement rate regulation of the latest retirement pension, people will receive 1% of the retirement pension replacement rate for the full year-paid retirement pension. The retirement pension replacement rate that this paper adopts is 35%.

As living costs after retirement are reduced greatly in terms of transportation and social intercourse costs, the retirement living cost will be reduced to 20%. The China Statistical Yearbook data on the per capita income and expenditure of China's residents in 2014 show that China's consumption expenditure per capita is 13,220 yuan/year. As a result, the retired elderly cut back 2644 yuan/year each

year. The retirement leisure utility of the elderly is increased by 7.88% as the baseline because of the logarithmic utility function. The estimated value of consumption time preference made by Gu & Xiao (2004) varies between 0.01 to 0.03, and the consumption time preference value that this paper adopts is 0.02.

As the flexible retirement system implemented in local areas in China mainly aims at senior technical personnel, such as senior management, technical and skilled personnel, no provision exists for two parameters, that is, pension penalty rate for early retirement and pension reward rate for deferred retirement. The retirement pension reward rates of the flexible retirement system in Germany and America are high, reaching 3% and 6%¹, respectively. The penalty rates of early retirement pension in these two countries are 3.6% and 6.8%, respectively. When pension replacement rate is 60%, pension reward rates for deferred retirement in these two countries are 1.8% and 3.6%, respectively, and the retirement pension penalty rates are approximately 2.1% and 4.3%, respectively, which are relatively high and not advised to be implemented in China. The replacement rate of basic retirement pensions published in China in 2014 is calculated according to retirement pension payment years, with 1% retirement pension replacement rate acquired with retirement pension paid per year. Considering the encouragement and penalty factors, the reward rate of pension for deferred retirement is 1.5%, and the penalty rate of pension for early retirement is 1.5%.

In summary, the concrete data used in numerical experiments in this paper include $\beta = 0.0213$: wage growth rate, $\theta = 0.02$: personal consumption time preference coefficient, $r = 4.6\%$: interest rate, $\lambda = 0.20$: pension payment rate, $w = 20000$: average starting salary, $l = 7.88$: retirement leisure life utility, $D = 75$: life expectancy per capita, $S = 20$: initial working age, $D = 75$: age of death, $M = 60$: statutory retirement age, $\mu = 0.015$: pension penalty rate for early retirement and $\nu = 0.015$: pension reward rate for delayed retirement.

Considering that the constraint condition of personal life cycle model is a piece-wise function, the mathematical model used in this paper does not have the analytic solution of optimal retirement age, so the numerical experiment is carried out using Matlab7.0. The main algorithm is shown as follows:

Step 1: Take the retirement age as 1 in the beginning to the age of death.

Step 2: Calculate the discounted value of the total consumption of life cycle for different retirement ages by Formulas (2) and (5).

Step 3: Calculate the total utility of the life cycle of different retirement age by Formula (5), combined with Formula (1).

Step 4: Compare the total utility of the life cycle of different retirement age and find the optimal retirement age to maximise its effectiveness.

The following is the numerical experiment result:

The numerical experiment in **Figure 2** is based on the fact that pension penalty rate for early retirement and pension reward rate for deferred retirement are

¹Data source in this section: Social Security Programs Throughout the World: Africa <2015>; Americas <2015>; Europe <2014>; Asia and the Pacific <2014>.



Figure 2. Optimum retirement age with increasing life expectancy.

both 0.015, indicating that optimal retirement age is an increasing function of life expectancy. Under the condition that life expectancy is 75 years, the optimal retirement age under flexible retirement system is 62.6 years old, which is 2.6 years higher than the current retirement age. When life expectancy is 88 years, the optimal retirement age under flexible retirement system is 65.8 years old, whereas the optimal retirement age without flexible retirement system is 1.2 years younger than that of 64.6 years old, which shows that flexible retirement system encourages individuals to choose delayed retirement in the case of ageing population.

The numerical experiment in **Figure 3** is based on the fact that the reward rate for delayed retirement is 0.01, indicating that penalty rate for early retirement is an increasing function of the optimal retirement age. When life expectancy is 75 years and the penalty rate for early retirement is 0.001, the optimal retirement age is 53. With the penalty rate increased to 0.01, the optimal retirement age is 59.8 years old, and when penalty rate for early retirement further increased to 0.011, the optimal retirement age is 62 years old. When penalty rate for early retirement is sufficiently high, rational individuals choose the 62-year-old retirement age to maximise their utility rather than 60 years old, because the penalty rate for early retirement will no longer affect the overall utility of the individual after 60 years old. Even if the penalty rate for early retirement further improves, the retirement age will not change.

Given the optimal age of the corresponding penalty rate for early retirement in different life expectancies, the longer the life expectancy is, the longer the optimal retirement age is. When penalty rate for early retirement is low, individuals start to postpone the retirement age because costs after retirement increase due to increased life expectancy, which makes individuals avoid suffering financial losses from penalty. In addition, the optimal retirement age curve shows a rising phenomenon. When life expectancy is 75 years, the increase of penalty rate for early retirement is a main factor for people to postpone the retirement age. At present, under the condition that the average life expectancy of our

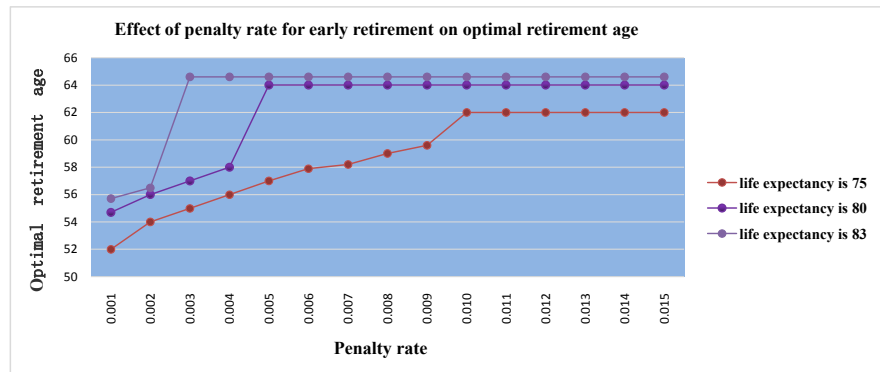


Figure 3. Effect of penalty rate for early retirement on optimal retirement age.

country is not too high, establishing a flexible retirement system is necessary, and early retirement can be restrained by setting an appropriate penalty rate.

The numerical experiment in **Figure 4** is based on the fact that the penalty rate for early retirement is 0.01, indicating that the reward rate for delayed retirement is an increasing function of the optimal retirement age. When life expectancy is 75 years, and reward rate for delayed retirement is 0.01, the optimal retirement age is 58.6 years old in the flexible retirement system and the reward rate is 0.022. When reward rate for delayed retirement increased to 0.024, the optimal retirement age is raised to 62.4 years old from 58.6 years old and begins to rise with the increase in delayed retirement incentives. Compared with the curve of optimal retirement age when life expectancy is 77 and 80 years, the optimal retirement age becomes larger with the increase in life expectancy, and retirement age exceeds 60 years old when reward rate for delayed retirement is 0.016 and 0.018, respectively.

The numerical experiment in **Figure 5** based on the fact that the reward rate for deferred retirement and penalty rate for early retirement are both 0.015, indicating that the optimal retirement age is the reduced function of retirement leisure utility, and the optimal retirement age decreases with the increase of the retirement leisure utility. From the curve of optimal retirement age in different life expectancy, the greater the expected life expectancy is, the greater the optimal retirement age will be. A lower optimal retirement age corresponds to a higher retired leisure utility. As shown in **Figure 5**, when the life expectancy is 75, the retired leisure utility of the optimal retirement age of 61.5 years is much higher than that of the optimal retirement age of 62.5 years. Higher retired leisure utility means higher consumption and living costs after retirement. Considering the fact that China is in a low-welfare society, high retirement life utility is not the optimal decision of individuals, and therefore appropriate increase in retirement age is more consistent with the reality and conducive to increasing the overall individual utility.

5. Conclusion

The numerical test results of the optimal retirement age under flexible retirement

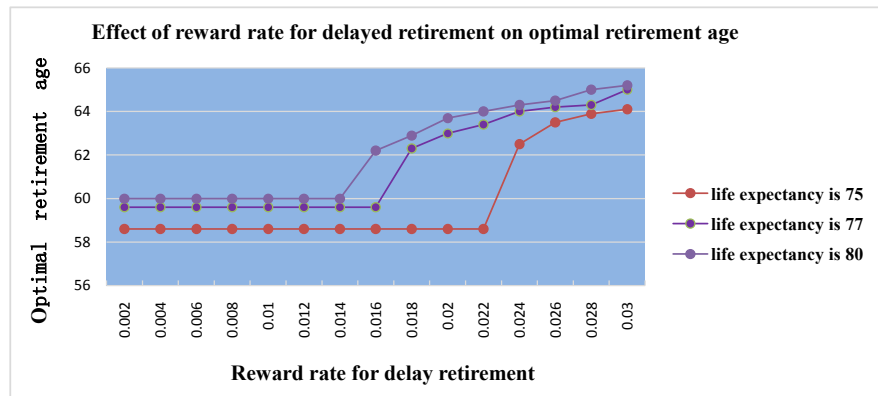


Figure 4. Effect of reward rate for delayed retirement on optimal retirement age.

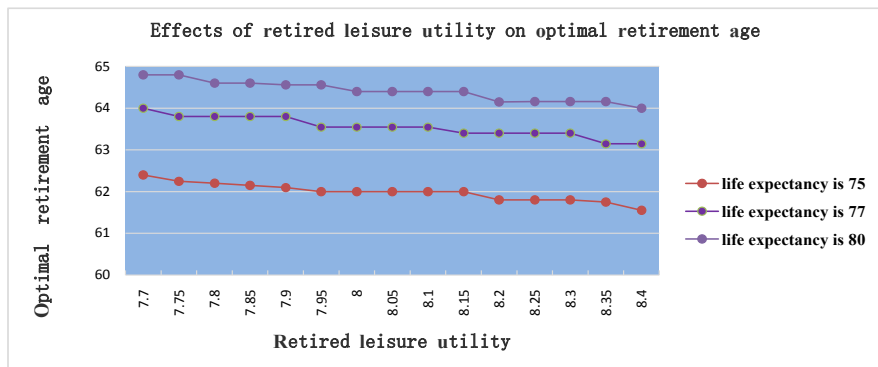


Figure 5. Effects of retired leisure utility on optimal retirement age.

system illustrate that under the condition that both the deferred retirement reward and early retirement penalty rates are 0.015, the optimal retirement age under the flexible retirement system is 62.6 years old, which is 2.6 years higher than the current 60 years old, and the purpose of deferred-stage retirement age is achieved. The research also indicates that the optimal retirement age is the increasing function of life expectancy. Under the condition that China's ageing population is intensified, population life expectancy and individual rational optimal retirement age are increasing, the retirement age of 60 years old in China will not adapt to the economic and social needs of the future. Thus, the retirement age should be increased appropriately.

The reward rate for deferred retirement is the increasing function of the optimal retirement age as seen from the influence analysis of flexible retirement system. The appropriate reward for deferred retirees will prompt rational individual workers to make their personal deferred retirement decisions to maximise the total utility of the individual life cycle. In addition, appropriate penalty rate for early retirement will also allow rational individual workers to give up personal early retirement decision to reduce pension losses. The optimal retirement age is the reduction function of retirement leisure effectiveness and under the condition that China is still a low welfare society, lower retirement age is not the optimal individual decision. The retirement age can be increased appropriately.

No specific stipulation exists in the deferred retirement policy in China, and the poll shows that most people do not support deferred retirement. Based on the analysis of the numerical experiment results of flexible retirement system in this paper, under the condition that the retirement age is maintained at 60 years old, avoiding early retirement by appropriate deferred retirement reward and early retirement penalty rates and encouraging workers to make deferred retirement decisions in a rational manner are possible. Before implementing the deferred retirement policy, adapting flexible retirement system as a transition and properly setting up the reward rate for deferred retirement can prompt workers to make optimal choices of deferred retirement, thereby achieving the goal of the deferred retirement policy. Studying the optimal retirement age under the flexible retirement system is significant as it reduces resistance of reform and achieves the effect of improving average retirement age, which contributes to the implementary of deferred retirement policy in current China.

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