Raising Retirement Age, TFP and Elderly Welfare in China

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Abstract: *The fact that China is facing the challenge of aging population has led to debates about whether the government should raise the retirement age. The current pension system in China is characterized by the collection of contributions on payment and adopts the defined benefit (DB) plan. Considering the welfare effects of intergenerational support, this paper develops a dynamic general equilibrium model to investigate how postponing retirement would affect the TFP and the welfare of the elderly. Utilizing realistic parameters, our simulation finds that raising the retirement age will benefit the welfare of the elderly. This conclusion remains robust after a sensitivity analysis with respect to core parameters, the average age of the working population, and the pension system. However, opinion polls have found that most people oppose delaying retirement. This stems from the absence of pension transfer payments and pension system inequalities. The policy implications of this paper are twofold: Firstly, the government should convince the public about the benefits of delaying retirement; secondly, it is necessary to introduce supportive policies facilitating the implementation of delayed retirement (e.g. increasing the replacement rate of pensions or implementing a healthy aging strategy), and the retirement policy should be differentiated for people from various socio-economic backgrounds.*

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1. Introduction

There were 241 million elderly persons in China aged at or above 60 years at the end of 2017. Their share in the total population reached 17.3%, more than 7 percentage points above the international alert line of 10%. In 2017, for the first time, China's aging population grew by more than 10 million. The population of China's elderly is expected to reach 487 million by 2050, or 34.9% of the total population. This will make China one of the oldest countries in the world. Ensuring the old-age benefits before 2050 is one of the important contents of the "centennial goals[1]." Faced with a slowing economy, China's increasingly aging society lays heavier burdens on the working population and mounting pension payment pressures. The security of the welfare of the elderly bears great significance in the achievement of the "two centennial goals." In preparing for the silver economy and longevity risk, the Chinese government has been mulling a plan to raise the retirement age to ease pension payment pressures and

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[1] To build a moderately prosperous society in all respects and build a modern socialist country that is prosperous, strong, democratic, culturally advanced and harmonious.

improve the welfare of the elderly. The details of the plan have not yet been released, partly because academics' assessments on would-be effects of raising the retirement age are yet to be convincing to policymakers and the public. For instance, agreement has not yet been reached on central issues such as whether raising the retirement age would improve the welfare of the elderly. Most studies on the effects of raising the retirement age on the welfare of the elderly have focused on the financial status of the social pension fund and personal incomes and have reached different conclusions.

In regards to the financial status of the social pension fund, some academics have asserted that raising the retirement age would increase the sustainability of the social pension fund system and raise the welfare level for the elderly. Based on an actuarial model, Yu and Zeng (2015) found that raising the retirement age would reduce pension fund gaps and increase the sustainability of the social pension fund system. Based on an actuarial model, Yu *et al*. (2015), considering various types of employees, retirement age scenarios and seniority pay, found that raising the retirement age could significantly ease pension payment pressures and increase the sustainability of the social pension insurance fund. It was also discovered that the impact on pension payments for the younger generation is greater than that for the middle generation. Based on samples from developed countries, Karlstrom *et al.* (2004) and Galasso (2008) reached similar conclusions. By creating an intertemporal iterative model that contains a plan to raise the retirement age, Yan (2017) found that postponing retirement would increase the replacement rate of the pension fund, and thus improve pension benefits for the elderly. Yet some academics disagreed. Weller (2002) and Miyazaki (2014) found that raising the retirement age would do little to ease the pension fund shortage at the expense of a shrinking tax base and would significantly cut pension benefits for the low-income group. In the long run, raising the retirement age is of little help in addressing the pension payment crisis.

In the dimension of personal pension wealth, some academics considered that raising the retirement age would increase the personal pension wealth. Through numerical simulation based on an actuarial model of pension expectations, Yang *et al*. (2014) uncovered that raising the retirement age would increase female employees' pension wealth and the pension wealth of male employees who participated in a pension insurance plan after the age of 32. Based on the pension wealth profit and loss model and the cross-over analysis on the personal pension wealth effects of raising the retirement age, Yu (2014) found that how and to what extent raising the retirement age would influence personal pension wealth depended on different parametric combinations, and that under realistic parameters, raising the retirement age would increase personal pension fund wealth, especially for women. Some academics held opposing views: Stock and Wise's (1990) option value model suggested that raising the retirement age would reduce personal pension wealth. Liu's (2013) pension wealth model led to the conclusion that the employee welfare effects of raising the retirement age were subject to pension parameter combinations, i.e. higher wage growth rate is conducive to raising the retirement age, while a slower pension growth or a higher pension discount rate is more unfavorable to raising the retirement age. After conducting a theoretical analysis with the generational overlap model under the neoclassical growth model framework, Fanti (2014) found that raising the retirement age would diminish pension wealth. Lin and Lin's (2015) study based on the option present value model discovered that raising the retirement age would cause significant economic losses for male and low-income workers and, in certain conditions, also harm the economic welfare of female employees. Using 2012 data of Shanghai and Guangdong, Sichuan and Liaoning provinces from the China Urban Household Survey, Feng (2017) employed a micro-econometric method to examine the effects of raising the retirement age on pension wealth for various types of employees and found that raising the retirement age would decrease personal pension wealth, especially pension wealth in the personal accounts of male employees.

Compared with existing studies, this paper offers the following contributions: While previous studies have seldom examined the welfare effects of postponing retirement from an intergenerational support perspective, this paper examines, at the societal and individual levels, the effects of raising the retirement age on the elderly in relation to the cultural context of intergenerational support. Hence, our findings are more relevant to China's reality. With respect to research methodology, most academics have employed actuarial and econometric models, both of which have specified many parameters endogenous to and influenced by the policy of raising the retirement age as exogenous variables. Such specifications cannot precisely simulate decision-making in the real world. To avoid this problem, this paper uses a dynamic general equilibrium framework in considering the economic effects of raising the retirement age on the elderly. Although some academics have examined the welfare effects of raising the retirement age under a dynamic general equilibrium model framework (Fanti, 2014; Yan, 2017), they have overlooked the TFP effects of raising the retirement age and thus failed to capture the welfare effects for the elderly. China's current pension system bases the collection of contributions on payment and adopts the defined benefit (DB) plan. Most studies did not fully consider this and how postponing retirement would influence the average age of the working population, thus losing sight of the TFP effect of delaying retirement. To make up for the inadequacies of previous research, this paper investigates how raising the retirement age would influence the TFP from the economic welfare perspective of intergenerational support, and answers questions such as whether raising the retirement age will improve the economic welfare of the elderly under a dynamic general equilibrium framework. The reliability of this paper's conclusions is tested by altering the average age of the working population corresponding to the TFP stationary point and the values of core parameters in the model and conducting a sensitivity analysis of the pension system that bases contributions on payment.

2. Theoretical Framework

2.1 Basic Model

In specifying the utility function, we mainly referenced Barro and Becker(1989) and Yang(2016) and define the inter-temporal substitution elasticity of consumption as σ, the weight of future consumption as β, and the weights of consumption by children and the elderly as γ and χ. Considering the pension insurance system of defined benefits (DB) for China's urban employees, the elderly support coefficient or pension replacement rate under the system is ϕ_1, and the spending on raising a child as a share of wage income is specified to be μ. Consumption spending and savings in period i are marked as C_i^1 and S_i, and income return in period $i+1$ is specified as C_i^2; wage, human capital and interest rate levels in period i are marked as w_i, h_i and r_i; the numbers of adolescents, working-age and elderly populations are marked as H_i, L_i, O_i and g_i; populations aged j and populations about to retire in period i are specified as $p_i(j)$ and J_i. Based on China's current retirement age, we specify the average age when a person exits the labor market to be 54 years, i.e., $J_i=p_i(54)$.

Under the DB pension system, the average inter-generational support level for each elderly person is ϕ_1 times the average wage w_i of the working population in period i, and the total spending on elderly support in period i is $\phi_1 w_i O_i$; if the average spending on raising a child takes up μ percent of the average wage w_i of working populations, total spending on child-raising in period i is $H_i \mu w_i$; if consumer spending and savings in period i are C_i^1 and S_i, and total output in period i is Y_i, the budgetary constraint for working populations of period i in period i can be expressed as:

$$Y_i = C_i^1 + S_i + H_i \mu w_i + \phi_1 w_i O_i \quad (1)$$

Since C_i^1 has already occurred in period i, it directly goes into the utility function in the current period. According to the consumption nature of birth and the traditional virtues to raise children and support the elderly, spending on child-raising $H_i \mu w_i$ and elderly support $\phi_1 w_i O_i$ also goes into the utility function in period i. Savings S_i represents future consumption and yields $S_i(1+r_{i+1})$ units of return in period i+1. Considering the social rule that one may expect to be supported by his or her children only by raising children and caring for the elderly when in working age, if the survival rate is π_r, after spending $H_i\mu w_i+O_i\phi_1 w_i$ on child-raising and elderly support in period i, a working population expects to receive $\pi_r J_i\phi_1 w_{i+1}-(H_i\mu w_i+O_i\phi_1 w_i)J_i/L_i$ units of return in period i+1. Then, the budgetary constraint for working populations of period i in period i+1 would be:

$$C_i^2 = S_i(1 + r_{i+1}) + \pi_r J_i \phi w_{i+1} - (H_i\mu w_i + O_i\phi_1 w_i)\frac{J_i}{L_i} \quad (2)$$

Referencing Barro and Becker (1989), we specify the utility function as a power function of exponent σ. Considering that the utility of working populations stems from consumption, saving and spending on child-raising and elderly support, the objective function for decision-maker in period i is:

$$U_i = (C_i^1)^\sigma + \gamma(H_i\mu w_i)^\sigma + \chi(O_i\phi_1 w_i)^\sigma + \beta(C_i^2)^\sigma \quad (3)$$

Under the DB pension insurance system, decision-makers in period i need to decide how to optimally allocate output in period i to consumption, savings and supporting children and the elderly. Hence, they face the following decision-making equation:

$$\max_{C_i^1, C_i^2, S_i} U_i = \left(C_i^1\right)^\sigma + \gamma(H_i\mu w_i)^\sigma + \chi(O_i\phi_1 w_i)^\sigma + \beta\left(C_i^2\right)^\sigma$$
$$s.t\begin{cases} Y_i = C_i^1 + S_i + H_i\mu w_i + O_i\phi_1 w_i \\ C_i^2 = S_i(1 + r_{i+1}) + \pi_r J_i\phi_1 w_{i+1} - \frac{J_i}{L_i}(H_i\mu w_i + O_i\phi_1 w_i) \\ 0 \le \sigma, \beta, \gamma, \chi, \phi_1, \mu, \pi_r \le 1 \end{cases} \quad (4)$$

The decision result of the working population in period i is known. Considering the characteristic of the DB pension insurance system that bases pension security on funded savings, the intergenerational support level for each elderly person in each year is ϕ_1 times the average salary w_i of working populations. Hence, the pension level of each elderly person in period i can be approximately regarded as:

$$OI_{1,i} = \phi_1 w_i \quad (5)$$

To calculate the pension benefits in each period and the welfare effect of raising the retirement age for elderly persons, we should first determine the decision result of working populations in each period. As can be seen from equation (4), the optimal decision results of decision-makers in each period can be found if the values of parameters σ, β, ϕ_1, μ, γ, χ, π_r and the values of variables H_i, L_i, O_i, J_i and w_i, r_i are known, so that the pension effects of raising the retirement age can be revealed.

Such parameters as σ, β, ϕ_1, μ, γ, χ and π_r are determined exogenously from institutional systems, culture and social rules. For demographic forecasts under different retirement scenarios, please refer to Yu and Zeng's (2015) method.

To further determine the decisions of working populations, we should also know the values of variables w_i, w_{i+1}, r_{i+1} in each future period, while such variables as wage and interest rate are calculated with information from the production sectors. Here, we specify the production sector function to be the Cobb-Douglas production function and assume its return of scale to the constant. A_i is the total factor productivity (TFP); K_i is capital stock; h_i is human capital; the shares of capital and labor contributions are marked as α and $1-\alpha$, respectively. Then we have:

$$Y_i = A_i(K_i)^\alpha(h_i L_i)^{1-\alpha} \quad (6)$$

Based on the condition of profit maximization in the production sector, wage in the current period, wage in the next period and interest rate in the next period can be expressed as:

$$\begin{cases} w_i = A_i(1-\alpha)(K_i)^{\alpha}(h_i L_i)^{-\alpha} \\ w_{i+1} = A_{i+1}(1-\alpha)(K_{i+1})^{\alpha}(h_{i+1}L_{i+1})^{-\alpha} \\ r_{i+1} = A_{i+1}\alpha(K_{i+1})^{\alpha-1}(h_{i+1}L_{i+1})^{1-\alpha} \end{cases} \tag{7}$$

To calculate wage in the current period, wage in the next period and interest rate in the next period, we should also know total factor productivity A_i, capital stock K_i and human capital h_i.

According to Feyrer (2007), the relationship between TFP A_i and the average age g_i of working populations in OECD countries and China exhibits an inverted U-shaped pattern with the stationary point in the range between 40 and 49 years. After controlling for the stationary point values of the average age of working populations, we use a segmented linear relationship to approximate the inverted U-shaped non-linear relationship. To do so, the relationship between TFP $A_i(g_i)$ and the average age g_i of working populations are specified as:

$$A_i(g_i) = \begin{cases} kg_i + b, g_i \le g_i^* \\ -kg_i + 2kg_i^* + b, g_i > g_i^* \end{cases} \tag{8}$$

Where, g_i^* is the average age of working populations when TFP is at its maximum, and parameters k and b are deduced according to historical TFP and the average age of working populations.

The capital depreciation rate is assumed to be δ. Saving S_{i-1} equals investment I_{i-1}, and capital stock K_i in period i equals the capital stock K_{i-1} in period $i-1$ minus depreciation δK_{i-1} plus savings S_{i-1} in period $i-1$. Then, capital stock K_i in period i can be expressed as:

Referencing Lu and Cai (2014), if the average age of working populations is s_i, and the human capital level in the initial year is specified as $h_{2015}=1$, human capital h_i in period i is:

$$K_i = (1-\delta)K_{i-1} + S_{i-1} \tag{9}$$

$$h_i = e^{\varphi(s_i)-\varphi(s_{2015})} \tag{10}$$

Referencing Lu and Cai (2014), $\varphi(s_i)$ is assumed to be:

$$\varphi(s_i) = \begin{cases} 0.134(4-s_i), s_i \le 4 \\ 0.134*4 + 0.101(s_i - 4), 4 < s_i \le 8 \\ 0.134*4 + 0.101*4 + 0.068(s_i - 8), 8 < s_i \end{cases} \tag{11}$$

When the household sector achieves utility maximization and the production sector achieves profit maximization, the final decision for working populations to make is:

$$\max_{C_i^1, C_i^2, S_i} U_i = (C_i^1)^{\sigma} + \gamma(H_i\mu w_i)^{\sigma} + \chi(O_i\phi_1 w_i)^{\sigma} + \beta(C_i^2)^{\sigma}$$

$$s.t. \begin{cases} Y_i = C_i^1 + H_i\mu w_i + S_i + O_i\phi_1 w_i \\ C_i^2 = S_i(1+r_{i+1}) + \pi_r J_i\phi_1 w_{i+1} - \frac{J_i}{L_i}(H_i\mu w_i + O_i\phi_1 w_i) \\ w_i = A_{i+1}(g_i)(1-\alpha)(h_i)^{1-\alpha}(K_i)^{\alpha}(L_i)^{-\alpha} \\ w_{i+1} = A_{i+1}(g_i)(1-\alpha)(h_{i+1})^{1-\alpha}(K_{i+1})^{\alpha}(L_{i+1})^{-\alpha} \\ r_{i+1} = A_i(g_i)\alpha(h_{i+1})^{1-\alpha}(K_{i+1})^{\alpha-1}(L_{i+1})^{1-\alpha} \\ K_{i+1} = (1-\delta)K_i + S_i \\ h_i = e^{\varphi(s_i)-\varphi(s_{2015})} \\ 0 \le \sigma, \beta, \gamma, \chi, \phi_1, \mu, \pi_r \le 1 \end{cases} \tag{12}$$

Notably, the above model contains two basic assumptions: first, the mechanism through which late retirement will influence elderly welfare is free from defects or impediments; second, the existing

Table 1: Specifications of Key Parameters

Parameter	Specified value	Basis
Intertemporal substitution elasticity σ	0.85	References Yang's (2018) specification
Discount factor β	0.95	References Kang and Chu's (2014) specification
Weight coefficient assigned to spending on child-raising γ	0.9	References Peng *et al.*'s (2018) specification
Weight coefficient assigned to spending on supporting the elderly χ	0.8	References Peng *et al.*'s (2018) specification and China's traditional culture of caring for the elderly
Child-raising coefficient μ	0.8	References Liao (2013) with the additional calculations
Pension replacement rate ϕ_1	0.6	Target replacement rate prescribed in the *State Council Decisions on Creating a Unified Basic Pension Insurance System for Corporate Employees* (Guo Fa [1997] No.26)
Share of capital contribution α	0.5	References Zhu *et al.* (2014)
Survival rate of retiring populations π_r	0.994	Calculated based on the Sixth Demographic Census
Stationary point of TFP g_i^*	40 years old	References Feyrer (2007)
Depreciation rate δ	0.05	References Chen's (2014) specification

pension system is fair to the extent that raising the retirement age exerts homogeneous effects on the welfare of the elderly.

2.2 Specifications of Key Parameters

With the values of the above variables and other parameters already known, we may conduct a simulation analysis based on equation (12) on how raising the retirement age will influence elderly welfare. Before conducting a numerical simulation, the initial values of some variables and parametric values are provided according to the actual situation and specifications by academics(see table 1).

2.3 Retirement Age Scenarios

Without affecting our conclusions, raising the retirement age is defined as delaying the age when people receive pension payments and exit the labor market. Here, no distinction is made between cities and the countryside, between sectors, and between social groups. We devise three retirement scenarios: First, benchmark scenario (benchmark line, BI), i.e., the average retirement age of the working population since 54 years; second, gradually delayed retirement (GDR) scenario, i.e., retirement age is raised by half a year every year, and a cohort exits the labor market every other year; after 2035, the age when people exit the labor market will be fixed at 64 years; third, immediately delayed retirement (IDR), i.e., all cohorts yet to retire will not exit the labor market until the age of 64.

3. Simulation Results

As can be seen from Figure 1, under Scenario 1 where retirement age will not be raised, the average age of working populations will slightly increase initially from the current 36.5 years and then gradually

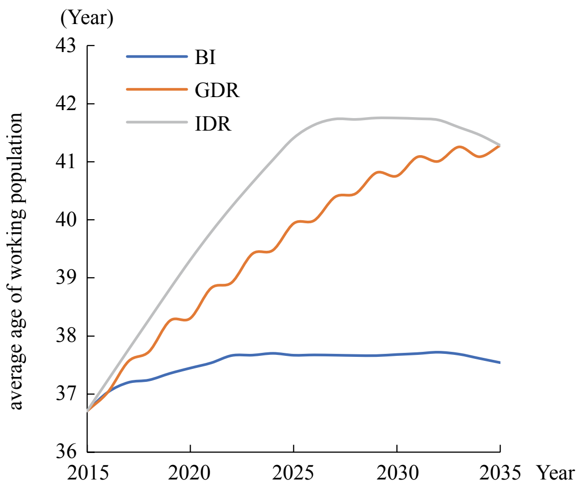

Figure 1: Effect of Raising the Retirement Age on the Average Age of the Working Population

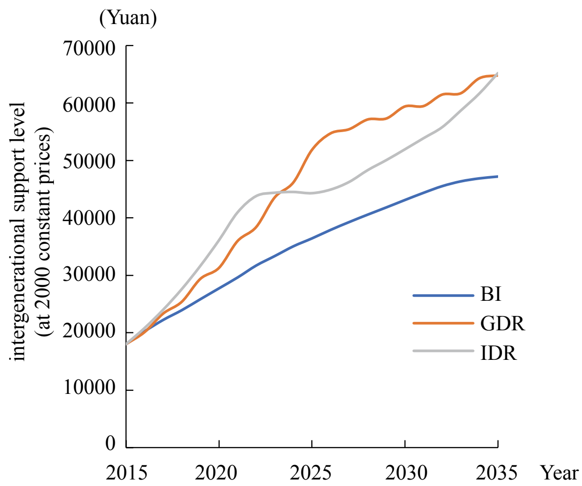

Figure 2: Effect of Raising the Retirement Age on the Welfare of the Elderly

stabilize at 37.5 years by 2025 and stay around this level thereafter. Under Scenario 2 where retirement age will be gradually raised, the average age of working populations will keep increasing from 36.5 years in 2015 to around 41 years in 2035; under Scenario 3 where retirement age will be immediately raised, the average age of working populations will initially rise steeply from the current 36.5 years to reach 41.5 years by 2025 and then gradually decrease to around 41 years by 2035. According to Feyrer (2007), the average age of working populations at the stationary point of TFP is in the range between 40 and 49, which means that the average age of China's working populations when China's TFP reaches the maximum level will be no less than 42 years. Compared with the baseline scenario, raising the retirement age no matter gradually or immediately will all increase TFP.

As shown in Figure 2, under the current pension system, elderly welfare tends to increase in the future no matter under which scenario of raising the retirement age: the level of pension welfare for the elderly will be higher under the scenario of raising the retirement age and under the scenario of maintaining the current retirement age. Before 2025, the level of pension welfare for the elderly under the scenario of gradually raising the retirement age will be slightly lower than under the scenario of immediately raising the retirement age. Yet after 2025, the pension welfare for the elderly will be higher under the scenario of gradually raising the retirement age than under the scenario of immediately raising the retirement age.

The question is why a rise in retirement age will lead to better pension welfare for the elderly? Judging by equation (5) $OI_{1,i} = \phi_1 w_i = \phi_1(1-\alpha)\ A_i(g_i)(h_i)^{1-\alpha}(K_i/L_i)^{\alpha}$, raising the retirement age influences elderly welfare in three ways: first, the elderly welfare effects of late retirement are not influenced by the pension replacement rate ϕ_1 and the share of capital contribution α, both of which are constants.

Second, welfare effects for the elderly are negatively influenced by the capital-to-labor ratio K_i/L_i and human capital h_i. By increasing working populations and allowing the less educated to remain in the labor market, the policy of raising the retirement age will reduce the capital-to-labor ratio and human capital (Miyazaki, 2014).

Third, the pension effect of raising the retirement age is positively influenced by TFP. Under the scenario where retirement age is not raised before 2035, the average age of working populations will be less than 38 years. Considering that TFP will be the highest when the average age of the working population is between 40 and 49 years, raising the retirement age will increase the average age of working populations are much closer to the average age of working populations at the stationary point of TFP, thus raising TFP.

Overall, the positive pension effect of raising the retirement age outweighs the negative effect on capital-to-labor ratio and human capital. In the final analysis, raising the retirement age will improve elderly welfare.

4. Robustness Analysis

In this section, we will test the robustness of the above conclusions. First, the above analysis assumes that the average age of working populations at the stationary point of TFP is 40 years. According to Feyrer (2007), the average age of working populations should be in the range between 40 and 49 years for the TFP of OECD countries and China reach the stationary point. Considering that the analysis results are the same no matter when the average age of working populations is no less than 43 years or at 43 years at the stationary point of TFP. Hence, we specify three scenarios when the average age of working populations is 41 years, 42 years and above 43 years at the stationary point of TFP.

Second, our conclusions could be sensitive to the main parameters in the household decision model such as intertemporal substitution elasticity, discount factor, birth cost coefficient and pension replacement rate. With sensitivity in mind, we assign two groups of values greater and smaller than the benchmark scenario for simulation analysis, respectively.

Lastly, since the above analysis is based on the defined benefit (DB) pension system, the question is whether the elderly will receive less pension if China's shift to a defined contribution (DC) pension system in the future? To test the robustness of our conclusions under this scenario, we perform a robustness analysis under the assumption that a DC pension system will be adopted in the future. Under the DC pension system, the objective function and constraint condition for working populations are:

$$\max_{C_i^1, C_i^2, S_i} U_i = (C_i^1)^\sigma + \gamma(H_i \mu w_i)^\sigma + \chi(\phi_2 w_i L_i)^\sigma + \beta(C_i^2)^\sigma$$

$$s.t.\begin{cases} C_i^1 = Y_i - S_i - H_i \mu w_i - \phi_2 w_i L_i \\ C_i^2 = S_i(1 + r_{i+1}) + \phi_2 w_{i+1} L_{i+1} \frac{\pi_r J_i}{O_{i+1}} - (H_i \mu w_i + \phi_2 w_i L_i) \frac{J_i}{L_i} \\ w_i = A_i(g_i)(1-\alpha)(h_i)^{1-\alpha}(K_i)^\alpha (L_i)^{-\alpha} \\ w_{i+1} = A_{i+1}(g_i)(1-\alpha)(h_{i+1})^{1-\alpha}(K_{i+1})^\alpha (L_{i+1})^{-\alpha} \\ r_{i+1} = A_{i+1}(g_i)\alpha(h_{i+1})^{1-\alpha}(K_{i+1})^{\alpha-1}(L_{i+1})^{1-\alpha} \\ K_{i+1} = (1-\delta)K_i + S_i \\ h_i = e^{\varphi(s_i) - \varphi(s_{2015})} \\ 0 \le \sigma, \beta, \phi_2, \gamma, \chi, \mu, \pi_r \le 1 \end{cases} \tag{13}$$

Considering China's pension system characteristics of basing collection on payment and defined benefit (DB), the total intergenerational support level for the elderly in each period equals total labor income $w_i L_i$ multiplied by elderly support coefficient ϕ_2 manifested as the pension replacement rate. Then, the pension welfare level for each retiree under the DB plan in period i is:

$$OI_{2,i} = \phi_2 w_i L_i / O_i = \phi_2 (1-\alpha) A_i(g_i)(h_i)^{1-\alpha}(K_i)^\alpha (L_i)^{1-\alpha} / O_i \tag{14}$$

4.1 Age of Working Populations

With the average age of working populations increases when TFP reaches its maximum value, the implication is that postponing retirement will move the actual average age of working populations closer to the stationary point of TFP and thus more significantly contribute to TFP improvement. As shown in

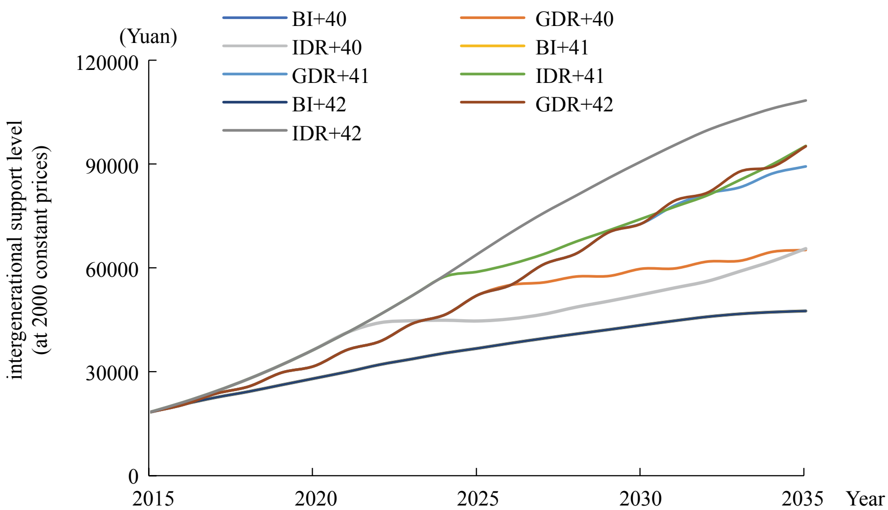

Figure 3: Change of Variable g_i^*

Figure 3, the conclusion that postponing retirement will improve elderly welfare remains unchanged. At the maximum value of TFP, the higher the average age of working populations is, the better effect postponing retirement will achieve, and the more likely it becomes for immediately raising the retirement age to yield better short-term effects than gradually raising the retirement age.

4.2 Change in Core Parameters

As can be seen from Figures 4-7, change in the intertemporal substitution elasticity σ did not lead to any change in the comparative result of pension benefits under the scenario of raising the retirement age relative to the baseline scenario, but changed the absolute values of pension benefits under different retirement scenarios. Change in discount factor β also did not lead to any change in the comparative result of pension benefits under the scenario of raising the retirement age relative to the baseline scenario, but incurred changes in the absolute value and trend of pension benefits under different retirement scenarios. Similarly, different cost coefficients of child-raising did not lead to any change in the comparative result of pension benefits under the different scenarios of raising the retirement age, but incurred change in the absolute value of pension benefits. Still, different pension replacement rates did not change the comparative result of pension benefits under various scenarios of raising the retirement age.

4.3 Pension Reform

As can be seen from Figure 5, if the intergenerational support model is transformed from defined benefit (DB) to defined contribution (DC), raising the retirement age will not worsen pension benefits for the elderly. On the contrary, postponing retirement will improve elderly welfare more significantly under the DC plan. Under the DC pension system that may be adopted in China in the future, raising the retirement age will significantly improve rather than reduce elderly welfare.

5. Further Discussions

Based on the above simulation, we found that postponing retirement will increase rather than reduce pension for the elderly. Yet most academics (Li and Peng, 2015) found in their survey that public opinion

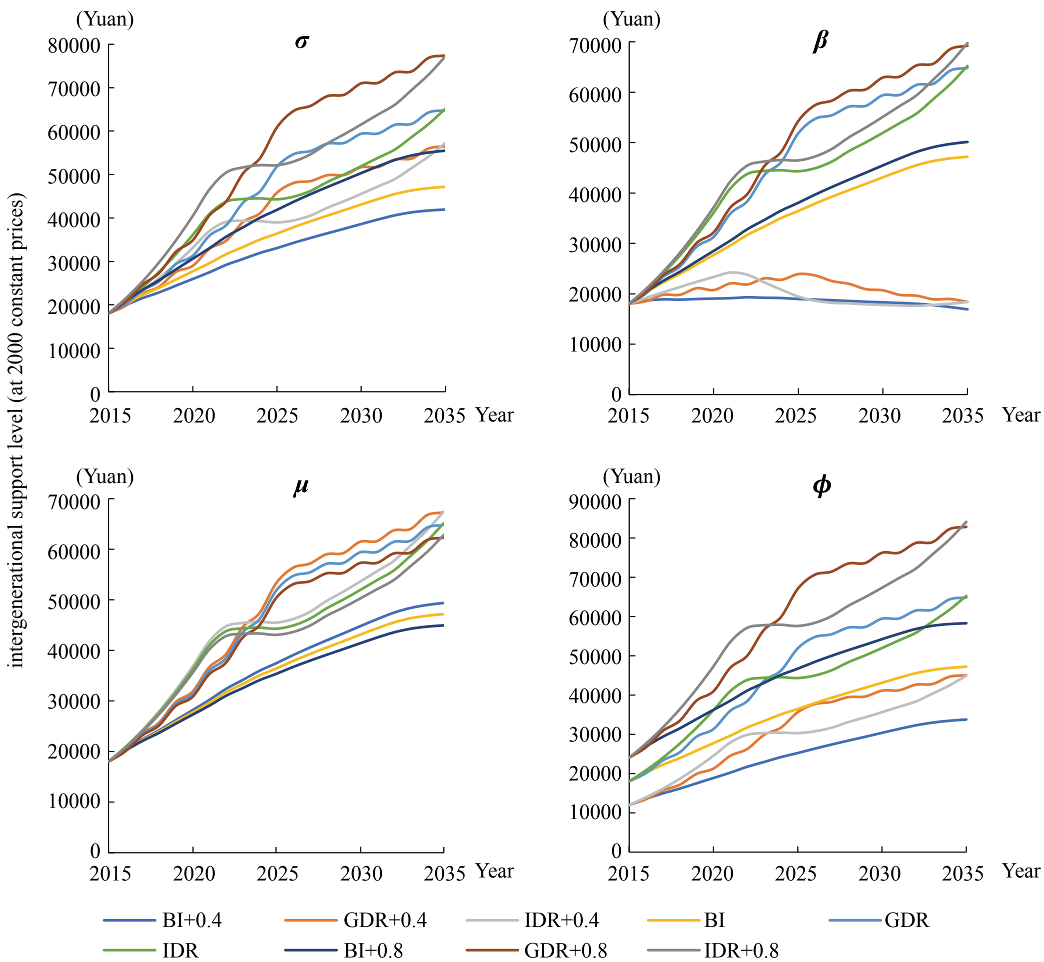

Figure 4: Change in Parameters

is against raising the retirement age. To find out the reasons, we have collected research samples through an online survey platform and performed statistical analysis with results shown in Table 2.

As can be seen from Table 2, 93.9% of respondents wished to retire at or before the current retirement age. They mentioned the following reasons for not wishing to delay retirement: (i) they wished to enjoy leisure time in retirement; (ii) they would be too old to remain healthy and energetic enough to stay in the workforce until becoming eligible to receive pension payments in full; (iii) they would have to take care of their grandchildren and other family members; (iv) staying the workforce in old age would deprive the younger generation of career opportunities; (v) raising the retirement age would increase the payment and collection inequalities of the current pension system; (vi) other reasons, e.g., salary income is not higher than pension; (vii) normal retirement age would give them more confidence to change job or start a business.

Public opinion is at odds with the results of theoretical research. After reviewing the theoretical model specifications, it can be found that raising the retirement age will improve economic elderly welfare only when there exists a mechanism that transfers the economic benefits from postponing retirement to the elderly people. Also, the model assumes the existing pension system to be fair, i.e., there is no difference between contributions and pension payments. Currently, the idea of raising the

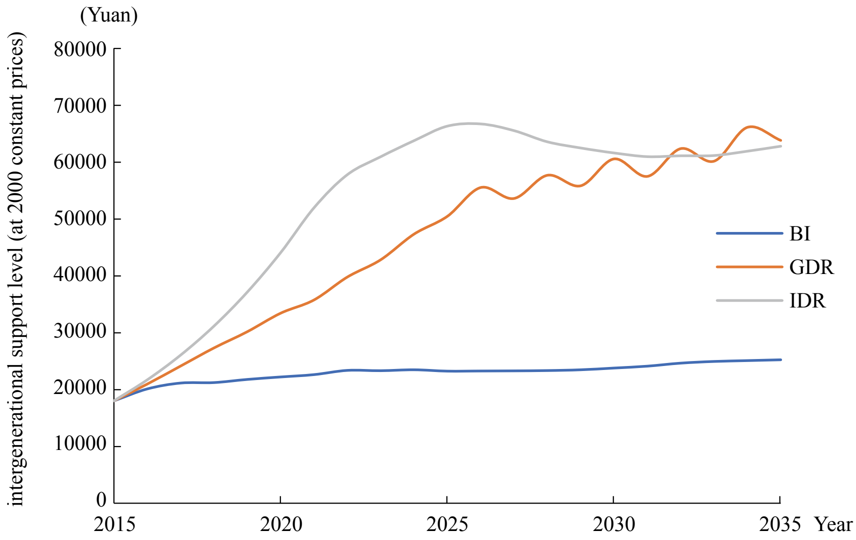

Figure 5: Pension Reform

retirement age is yet to be implemented in China, not to mention the transfer payment to increase elderly welfare. The question is how to avoid the economic welfare losses and inequalities as a result of postponing retirement under the current system? We suggest that (i) while implementing the policy to raise the retirement age, the government should adopt a mechanism or supporting policies to transfer the additional economic welfare from late retirement to the elderly people; (ii) and formulate differentiated policies to raise the retirement age to benefit specific sectors and social groups.

Some respondents worried that they would be too old to be working until the retirement age and become fully eligible for pension in full amount. To address their concern, policymakers should create a supporting transfer payment system while raising the retirement age. Specifically, the government may consider (i) raising the pension replacement rate or the growth rate of basic pension payment no higher than the economic growth rate; (ii) implementing the "healthy China" strategy, increasing the supply of public health services, and fostering public health awareness unhealthy lifestyles, so that the personal basic pension wealth losses resulting from late retirement are offset by a longer life expectancy; (iii) lowering the contribution rate of basic pension insurance. As for the concern over pension inequalities, a differentiated retirement policy should be adopted to make transfer payments to people from different socio-economic backgrounds under the same retirement age arrangement. Apart from economic welfare considerations, respondents who objected to late retirement also mentioned non-economic interests such as leisure and family care. To increase public acceptance of late retirement, the government should strive to promote work-life balance and provide more family care services and subsidies.

6. Concluding Remarks

In this paper, we have examined the question of whether raising the retirement age will improve elderly welfare. From an economic welfare perspective of intergenerational support, we have created a dynamic general equilibrium framework to investigate the TFP effects of raising the retirement age under China's current pension system of defined benefit (DB). With currently practical parameters, our simulation uncovered that although raising the retirement age would reduce the capital-to-labor ratio and human capital level, it will still increase pension welfare for the elderly by raising the average

Table 2: Public Opinions on Retirement Age

Question	Answer	Number of samples	Percentage
When do you wish to retire?	I wish to retire earlier than the current retirement age.	164	32.1
	I wish to retire at the current retirement age.	316	61.8
	I wish to retire later than the current retirement age	31	6.1
What are the reasons for your objection to raising the retirement age?	Retirement would allow me to enjoy leisure time	181	37.7
	I would be too old to remain healthy and energetic enough to stay in the workforce until becoming eligible to receive pension in full;	69	14.4
	I wish to take care of my grandchildren and other family members	67	14.0
	Staying the workforce in old age would deprive the younger generation of career opportunities	65	13.5
	Raising the retirement age would increase the payment and collection inequalities of the current pension system	39	8.1
	Other reasons, e.g., salary income is not higher than pension	34	7.1
	Normal retirement age would give me more confidence to change job or start a business.	25	5.2

age of working populations to come close to the level that corresponds to a maximum TFP. To test the reliability of our conclusions, we have performed a sensitivity analysis on the average age of working populations corresponding to the stationary point of TFP, main model parameters, and the pension system. Our findings suggest that: raising the average age of working populations to the stationary point of TFP does not change the fact that raising the retirement age will improve elderly welfare, but will increase the absolute values of pension welfare under different scenarios of postponing retirement, and better effects will be achieved if the retirement age is raised immediately instead of gradually; similarly, change in the core parameters of the model does not lead to any difference in the comparative results of elderly welfare under the scenario of raising the retirement age, but affects the absolute values and trend of elderly welfare under different retirement age scenarios; instead of changing the robustness of the above conclusions, an adjustment in pension system has increased the values of factor variables through various channels and improved TFP, thus making the above conclusions more reliable.

This paper's policy implications are as follows: (i) the government should convince the public that raising the retirement age is conducive to elderly welfare as demonstrated in this paper.

(ii) Pension reform is inevitable as the defined benefit (DB) system becomes unsustainable in an aging society. Should China's pension system move towards defined contribution (DC), the transition towards a higher retirement age will increase capital stock and working populations, reduce elderly populations, raise TFP, and greatly improve elderly welfare compared with the current pension system.

(iii) Our model assumes that the mechanism through which late retirement improves elderly welfare is free from impediment, and that the current pension system is fair for various social groups. Yet such assumptions are inconsistent with reality. For elderly welfare to improve in the manner shown in the simulated results, the government should adopt a differentiated retirement policy, introduce pension transfer payment, and promote a healthy aging society.

(iv) Aside from pension considerations, objection to postponing retirement also stems from the importance attached to leisure time and the traditional virtues of family duties. While raising the retirement age, therefore, the government should also strive to promote work-life balance and encourage and subsidize domestic services.

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