Calculation of the Optimal Social Pooling Pension Contribution Rate under the Three-child Policy

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ABSTRACT
Under the condition of maximization of social welfare and considering the influence of China's three-child policy, this paper establishes an optimal contribution rate model of old-age social pooling account under the three-child policy based on general equilibrium OLG, and analyzes the relationship between population growth rate and optimal contribution rate of social pooling account. With the decrease of population growth rate, the optimal contribution rate of social pooling account decreases. According to calculation, the optimal payment rate still shows a downward trend year by year after 2021. From the perspective of the effectiveness of China's three-child policy, although it has a certain impact on promoting population growth, this paper predicts that in the next five years after the implementation of the three-child policy, the optimal contribution rate of social pooling account will still decline slowly, and the impact of the three-child policy is not obvious. This shows that the effect of the decrease of population growth rate on the increase of wages and savings exceeds that of the decrease of the number of contributors.

Keywords: *endowment insurance, social pooling account, three-child policy, payment rate.*

1. INTRODUCTION

With the development of the economy and the improvement of the medical level, the life expectancy of the Chinese population continues to increase, but the fertility rate continues to decline. Ultimately, it inevitably accelerates the aging process of China's population. According to the data of the seventh census, in 2020, the number of people over 60 years old exceeded the number of children aged 0-14, which is the first time in Chinese history. In the future, the aging will be promoted at a faster speed, and China is likely to experience the fastest aging process in the world. As a policy response, the fertility policy has been significantly adjusted from a comprehensive two child policy to a three child policy to deal with the problem of population aging and negative population growth.

At the same time, facing a series of challenges such as economic fluctuations, external shocks and transformation and development, the Chinese government continued to implement the policy of tax reduction and fee reduction. The contribution ratio of pension insurance enterprises has been reduced from 20 % to 19 % and then to 16 %, which is of far-reaching significance to enhance enterprise confidence, stimulate economic vitality, ensure employment and enhance national competitiveness. However, considering the particularity of China's old-age security system and economic employment environment, under the background of population aging and continuous substantial fee reduction. Economic and social problems are becoming increasingly apparent, among which the more prominent is the sustainability of the basic endowment insurance fund system. Many researchers point out that there will be a huge revenue and expenditure gap in China's endowment insurance fund in the future. If effective measures are not taken as soon as possible, it is likely to lead to the pension "invisible debt" crisis and the problem of "empty account" of pension personal account. In 2020, the basic pensions of 11 provinces including Liaoning, Jilin and Heilongjiang were out of pocket in the current period, The national basic pension will have an annual fund gap after 2023, and the scale of the annual fund gap is becoming larger and larger. By 2050, the fund gap is expected to reach 76789.70 billion yuan.

Based on the three-child policy and the realistic background of appropriately reducing the social security contribution rate proposed in the "Thirteenth Five-Year Plan", this paper conducts numerical simulation analysis

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from the perspective of welfare maximization, combined with the actual situation in my country, and calculates and analyzes the optimal payment of the open three-child policy. It is expected to provide a decision-making reference for improving the pension insurance rate reduction policy.

2. RELATED WORKS

Zhang Li et al. [1] calculated the contribution rate of the pooling account considering the comprehensive opening of the two-child policy. Wan Chun [2] introduced the two-phase iterative model to measure the consumption effect, savings effect and other economic effect indicators of the payment rate. Yao Haiyang et al. [3] established the overlapping generation model of two-way altruistic and endogenous growth, and analyzed the stable growth path of this model, so as to obtain the relationship between birth rate and intergenerational net transfer rate, effective output per capita and enterprise payment rate. Jin Boyi et al. [4] studied the investment ratio between pooling accounts and individual accounts by using the portfolio theory, and calculated the optimal payment rate of pooling accounts.

3. MODEL

The OLG model in this paper is based on the model proposed by Diamond (1965) and combined with the main model framework of Yang Zaigui (2010). Assuming that there are three basic economic units in a closed economy: individual, enterprise and government. Among them,the individual's goal is to maximize the individual's life cycle utility, and the government's goal is to maximize social welfare on the basis of ensuring the balance of income and expenditure of pensions and public projects.

3.1. The Individual

An individual's life is limited and only exists for two periods: t period and $t+1$ period, each period is divided into the young and the old ,the same generation is homogeneous. The length of each period is assumed to be 1, and the old in each period have a survival time of $T(0 \leq T \leq 1)$. The population growth rate is $n = \frac{N_t^t}{N_t^{t-1}} - 1$, where N_t^t represents the number of workers in period t and N_t^{t-1} represents the number of workers in period t-1. In period t , those born in period t supply a unit of labor inelastically and earn a wage income of W_t, In period $t+1$, individuals born in period t must work for a given period of time Z $(0 \leq Z \leq T)$, earn a wage income of ZW_{t+1}, and then retire to enjoy leisure. In addition, it is assumed that the probability of living from work to retirement is 1. Therefore, the consumption in the retirement period mainly comes from the principal and interest of savings, individual account pension, social pooling account and the disposable income obtained from work during the delayed retirement period.The consumption of individuals in their youth and old age is shown in the following formula.

$$c_t^t = (1-\tau)w_t - s_t^t \tag{1}$$

$$c_{t+1}^t = (1+r_{t+1})s_t^t + Z(1-\tau)w_{t+1} + (T-Z)p_{t+1}^t \tag{2}$$

Where, c_t^t and c_{t+1}^t respectively represent the consumption of individuals in young age and old age. τ represents the payment rate of individual account, w_t and w_{t+1} represent salary, then the payment amount of individual account is τw_t. s_t^t is savings, r_{t+1} is interest rate, and p_{t+1} represents social pooling fund.

Assuming that the utility of an individual's life depends on consumption and leisure, the logarithmic function is used to reflect the utility level. We use U_t to represent the individual's lifetime utility, θ is the subjective utility discount rate, β is the individual's preference for leisure, and $T-Z$ is the rest period after retirement. A person's utility can be expressed as follows:

$$U_t = \ln(c_t^t) + \theta T(\ln\left(\frac{c_{t+1}^t}{T}\right) + \beta \ln\left(\frac{T-Z}{T}\right)], \theta > 0, \beta > 0 \tag{3}$$

Individuals can maximize their lifetime utility by choosing savings and two periods of consumption. By constructing Lagrange multiplier, the first-order condition for solving the utility maximization problem is Equation (4).

$$c_{t+1}^t = \theta T(1+r_{t+1})c_t^t \tag{4}$$

In Equation (2) - (4), assuming that the length of each period is 1, and the old in each period have a survival time of $T(0 \leq T \leq 1)$. Equation (4) is also the basic condition for the balance of social production and consumption.

3.2. The Enterprise

It is assumed that in a perfectly competitive market, firms' products are homogeneous and their production function is Cobb-Douglas function with constant return to scale:

$$Y_t = A * K_t^\alpha L_t^{1-\alpha}, 0 < \alpha < 1 \tag{5}$$

Where Y_t , K_t and L_t respectively represent the total output, capital stock and labor supply in period t, and α represents the level of technological progress.

In this paper, Equation (5) is transformed into the form of average labor:

$$f(k_t) = A * k^\alpha \tag{6}$$

Where $k_t = \frac{K_t}{L_t}$ represents average labor capital accumulation. Assuming that the depreciation rate of material capital in each period is δ, the manufacturer can maximize the profit level by selecting labor and capital.

According to the first-order condition of maximizing the profit of the manufacturer, we can get:

$$r_t = \alpha A * k_t^{\alpha-1} - \delta \tag{7}$$

$$w_t = (1-\alpha)Ak_t^{\alpha} \tag{8}$$

3.3. The Government

The government's responsibility in the pension system is to maintain the balance of funds and ensure that pensions are paid on time. Although China's current pension insurance system is a combination of unified accounts model, the cost of system transition has not been effectively resolved. This forced the government to squeeze funds from individual accounts to make up for the gap in the pooled account funds, resulting in a continuous increase in the scale of "empty accounts" in individual accounts. In the end, the nominal integration of accounts system has become a de facto accounting on the cash basis system. So the government only considers the balance of income and expenditure of the social pooling account, that is, it collects the social pooling pension insurance premium from the young population to pay the social pooling pension of the current retirees. We can get the pension budget balance formula of social pooling account is:

$$P_{t+1}^{t} = \frac{\tau w_{t+1}(Z+n+1)}{T-Z} \tag{9}$$

3.4. Market Equilibrium

Since this paper assumes that individual account pensions and individual savings are calculated together, the material capital in period t+1 comes from the savings of all young people in period t, as shown below:

$$K_{t+1} = N_t^t S_t^t \tag{10}$$

In addition, it is also necessary to meet the clearing conditions of the commodity market:

$$Y_t + (1-\delta)K_t = N_t^t c_t^t + TN_t^{t-1}c_t^{t-1} + K_{t+1} \tag{11}$$

3.5. Dynamic equilibrium system

We combine the decisions of individuals, enterprises and governments, and then solve the expressions of endogenous variables in the equilibrium state of the pension system under the condition of market clearing.The competitive equilibrium of this economy means that the variables of each period satisfy Equations (1) - (11). Substituting Equation (6) - (11) into Equation (4), the dynamic equilibrium equation described by the following difference equation is obtained:

$$\frac{Zk_{t+1}^{\alpha}}{(1-\delta+\alpha Ak_{t+1}^{\alpha-1})\theta T} + \frac{(1+\theta T)(1+n+Z)k_{t+1}}{(1-\alpha)(1-\tau)A\theta T} + \frac{(1+n+Z)\tau k_{t+1}^{\alpha}}{(1-\tau)(1-\delta+\alpha Ak_{t+1}^{\alpha-1})\theta T} = k_t^{\alpha} \tag{12}$$

It can be proved that as long as the value of differential $\frac{dk_{t+1}}{dk_t}$ at steady-state K is in the interval (0,1), the dynamic equilibrium equation has a unique, stable and non oscillatory steady-state equilibrium.When the stability conditions are met, the dynamic equilibrium system can be expressed as:

$$\frac{Z}{(1-\delta+\alpha Ak^{\alpha-1})\theta T} + \frac{(1+\theta T)(1+n+Z)k^{1-\alpha}}{(1-\alpha)(1-\tau)\theta AT} + \frac{(1+n+Z)\tau}{(1-\tau)(1-\delta+\alpha Ak^{\alpha-1})\theta T} = 1 \tag{13}$$

When the economy reaches the long-term steady-state level, the following steady-state equilibrium equations are obtained after removing the time subscript of each variable:

$$\begin{aligned} w &= (1-\alpha)Ak^{\alpha} \\ s &= (1+n+Z)k \\ r &= \alpha Ak^{\alpha-1} - \delta \\ c_1 &= (1-\tau)w - s \\ c_2 &= (1+r)s + (T-Z)p + (1-\tau)Zw \\ p &= \frac{(1+n+Z)\tau w}{T-Z} \end{aligned} \tag{14}$$

4. MAXIMIZATION OF SOCIAL WELFARE

We assume that the government is a social planner and formulates the optimal pension payment policy through the maximization of social welfare. The adjustment of policy variables can adjust the capital labor ratio to the level of the revised golden law, so as to maximize social welfare. According to the above setting of individual utility function, we get the following form of social welfare function:

$$\max U = \theta T\left(\ln\frac{c_1^0}{T} + \beta\ln\frac{T-Z}{T}\right) + \sum_{t=1}^{\infty}\varepsilon^{t-1}\left[\ln c_t^t + \theta T\left(\ln\frac{c_{t+1}^t}{T} + \beta\ln\frac{T-Z}{T}\right)\right] \tag{15}$$

Among them, $\varepsilon \in (0,1)$ is the social discount factor, which is the weight given to the typical individual utility of each generation in the calculation of social welfare, indicating the importance that social planners attach to the utility of each generation,other variables and parameters are the same as before. The labor resource constraints of the social planner problem are as follows:

$$Ak_t^{\alpha} + (1-\delta)k_t = (1+n)k_{t+1} + \frac{(1+n)c_t^t}{1+n+Z} + \frac{Tc_t^{t-1}}{1+n+Z} \tag{16}$$

The initial condition k_1 is known, and the final condition is $k_{\infty} = 0$. Under the condition of obeying resource constraints, initial conditions and ultimate conditions, social planners maximize the social welfare function by selecting the consumption of two periods and the level of labor capital stock of the next period. According to the research purpose, we mainly focus on the steady-state situation. By solving the maximized social welfare function, we obtain the following two first-order conditions:

$$\frac{\bar{c}_2}{\bar{c}_1} = \frac{(1+n)\tau}{\varepsilon} \tag{17}$$

$$\bar{k}=\left(\frac{1+N+\varepsilon\delta-\delta}{A\alpha\varepsilon}\right)^{1-\alpha} \tag{18}$$

In order to maximize social welfare in the stable state of market economy, the capital labor ratio in the stable state of market economy is adjusted to the level of the revised golden law by adjusting policy variables. Therefore, by substituting Equation (18) for Equation (13), we can deduce the expression of the optimal social pooling payment rate:

$$\frac{(1+\theta T)(1+n+Z)\alpha\varepsilon}{(1-\alpha)(1-\tau)(1+n+\tau\delta-\varepsilon)}+\frac{(1+n+Z)}{(1+n)(1-\tau)\theta T}+\frac{Z\varepsilon}{\theta T(1+n)}=1 \tag{19}$$

According to Equation (19), we can analyze the change trend of China's optimal payment rate under the condition that the fertility rate changes with time.

5. OPTIMAL CONTRIBUTION RATE OF PENSION SOCIAL POOLING ACCOUNT UNDER THE THREE CHILD POLICY

5.1. Determination of parameter value

According to Lin Zhongjing and Gong Liutang [5], the share of material capital income is 0.65, so the share of material capital output is 0.35. According to Shan Haojie [6], the annual capital depreciation rate is about 10%. Since each period is 30 years, the depreciation rate can be estimated to be 0.95. According to Kang chuankun and Chu Tianshu [7], when the annual growth rate of total factor productivity is 2.5% and each period is 30 years, the depreciation rate is 2.05 and the social discount factor is 48%. In addition, the discount rate is about 9% in the existing domestic literature [8].

Assuming that the average age of starting work is 20 years old, the proportion of men and women participating in work is similar. Since the legal retirement age is 60 for men and 50 for women, the average retirement age can be set to 55. The duration of each period is 30 years, and the average working time in the retirement period is 5 years. Therefore, the working time parameter of retirement period is 0.17. According to the China Statistical Yearbook, the average life expectancy of the national population in 2015 was 76.34 years. Therefore, the average survival time in the retirement period is 26.34 years. This indicates that the survival time parameter of retirement period is 0.88.

5.2. Analysis of optimal social overall payment rate and population growth rate

Then, we bring the above parameter values into Equation (19) to obtain the relationship between the fertility rate and the optimal payment rate of the social pooling account, as shown in figure 1. The units of X and Y axes in the figure are scale.

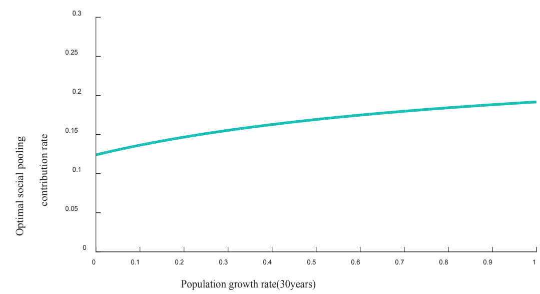

Figure 1 Relationship between the fertility rate and the optimal payment rate.

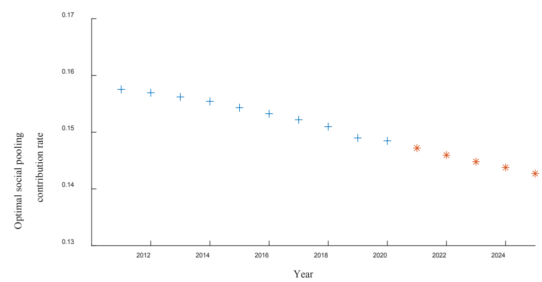

Figure 2 Optimal payment rate from 2011 to 2025.

Obviously, the lower the population growth rate, the lower the optimal social overall payment rate. This is because the population growth rate decreases, and the effect of the increase in wages and savings exceeds the effect of the decrease in the number of overall contributors. Combined with the data of China's population growth rate in recent 10 years and the prediction of population growth rate in the next five years after the opening of the three child policy, the optimal payment rate from 2011 to 2025 is in figure 2.

In figure 2, the unit of X axis is year, and the unit of Y axis is scale. It can be seen that the impact of the three-child policy on the trend of optimal payment rate is not obvious and does not change the overall trend of optimal payment rate decline. The optimal payment rate is 0.1472 in 2021 and 0.1460 in 2022, after which the optimal payment rate still shows a decreasing trend year by year.

6. CONCLUSION

Based on the general equilibrium OLG model framework, this paper quantitatively analyzes the relationship between the population growth rate and the optimal contribution rate of the social pooling account. The results show that the greater the population growth rate, the higher the optimal social pooling contribution rate. Under the condition of controlling other variables as known, combined with the background of China's three-child policy and fee reduction, and based on the population growth rate in the next five years, the optimal contribution rate of social pooling account in the next five years is calculated by the condition of social welfare maximization. Although the three-child policy will promote population growth to a certain extent, it will not affect the trend of the optimal payment rate. Obviously, it does not change the overall trend of the decline in the optimal payment rate. When calculating the optimal payment rate, it is assumed that some index data are given and unchanged, and only limited parameters are considered. Therefore, in the follow-up research, we will set the dynamic change of relevant parameters over time and analyze the change rule of optimal payment rate on this basis.

AUTHORS' CONTRIBUTIONS

Mile Deng contributed significantly to the model construction and performed the experiment;

Jiuru Zhu contributed to model construction, data collation and collection;

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