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POPULATION AGING, CAPITAL GAINS AND ADJUSTMENT OF FERTILITY POLICY

Song Fang, Lemeng Qi, Nini Song, Zhijuan Mao*
School of Management, University of Shanghai for Science and Technology, Shanghai 201210, China.

Abstract: The trend characteristics of capital income under population aging are related to investors' judgment of China's future investment environment, the effect of monetary policy regulation and the success or failure of pension system reform. In the critical period of the two centenary goals, will China's capital income enter a downward channel? To answer this scientific question, a dynamic model that can examine the impact of aging on capital income over the years. After optimizing the framework and conducting numerical simulation research based on realistic and feasible parameters, it is found that China's capital gains will enter a downward channel before 2050 under the condition that the birth policy remains unchanged. This means that there is a risk of capital outflow, and the capital engine of the Chinese economy may be underpowered; capital income will decline, and the role of monetary policy in regulating the macroeconomy will be reduced; the reform of the funded pension system is not a panacea, and personal pensions are faced with the problem of not being able to appreciate the insurance risk. Further simulations show that the adjustment of the birth policy not only increases future capital returns, but also changes the trend of declining capital returns after 2035. Therefore, it is necessary to further relax birth control and introduce birth support policies to increase the current birth level; birth policy is not only an important population policy, but may also be an important capital policy, and even a technological policy.
Keywords: Baby boom; Population aging; Capital gains; Birth policy

1 INTRODUCTION AND LITERATURE REVIEW

Along with the population generation change, China's "Baby Boomers" born in the 1960s will gradually reach retirement age, and the "Baby Boomers" born in the 1990s and 2000s will gradually enter the labor market. The withdrawal of the ultra-large-scale generation and the entry of the ultra-small-scale generation have led to a cliff-like decline in the working-age population, a sharp increase in the elderly population, and a wave of aging. Against such a realistic background, China's economic growth rate continued to decline from about 14% in 2007 to less than 7% in 2015. The period from 2015 to 2050 is a critical period for China to achieve the two centennial goals, and it is also a period of rapid population aging. In the face of menacing population aging, will capital gains enter a downward path? Population aging will affect future factor prices, In particular, what impact will capital prices have? The answers to the above scientific questions have extremely important practical and policy implications: First, it concerns investors' judgment of China's future investment environment. In the absence of capital and FDI, whether China's economy can continue to push toward the two centennial goals by relying on capital and FDI; second, it is related to the effectiveness of macro-control policies such as fiscal and monetary policies in the future, that is, in the face of a future economic slowdown Growth rate, whether the Chinese government can help China's industrial structure transformation through macro policy regulation, so as to promote the continued development of China's economy; third, it is related to whether future savings or personal account pensions can appreciate or maintain value, that is, under the aging Whether pension funds can be effectively invested and whether capital gains can outperform inflation will directly affect the welfare of the elderly population.

Regarding the research on the effect of population aging on capital gains, scholars mainly discuss it from two perspectives: theory and experience. On the theoretical level, Shi and Chen [1], Brooks [2],

Brooks [3] respectively constructed generational overlap models based on life cycle theory, and found through theoretical simulation that population aging It will increase the demand for safe asset bonds, raise bond prices and capital-labor ratio, and then reduce the interest rate represented by capital gains; Croix et al. [4] , Ikeda and Saito [5] , Kara and Von [6] respectively incorporated frictional factors in the labor market, population structure changes, and currency factors into the overlapping generations model. The influence of aging on capital income is examined within the framework of equilibrium. Numerical simulations show that aging will reduce future capital income and equilibrium interest rates, while the increase in total factor productivity can greatly increase the level of long-term interest rates. On the empirical level, Nguyen and Stüzle [7], Zhao Jian [8], Chen Guojin and Li Wei [9], Ma Li and Zhang Fangzhou [10] are based on developed countries, Some developing countries and individual developed countries have conducted empirical studies and found that population aging will reduce capital gains and global real interest rates, which is basically consistent with the above theoretical simulation results. However, Poterba [11] and Poterba [12] found different conclusions after conducting empirical research based on samples from the United States, other developed countries, and developing countries. Domestic scholars have only discussed it from the empirical level. For example, Zhang Chunsheng and Jiang Hai [13] deduced after combing the text that China's interest rate may be at a low level before 2040, and then it will show an upward trend; Qi Mingzhu [14] based on China's data from 1990 to 2015, using the VAR model, found that population aging has a long-term significant negative impact on financial asset prices, although population aging will not cause financial asset prices to collapse, but it must Be wary of the risks brought by the decline in asset prices under the aging population in the future to the appreciation and preservation of pensions.

Regarding the research on the effect of population aging on capital gains, the existing literature has done in-depth analysis and achieved fruitful results, but there is still some room for expansion in terms of research perspective, research content and research methods. First, from the perspective of research, although there are studies by Qi Mingzhu and others, there are few studies on China's capital return rate, especially during the period when China's population aging affects the capital return rate during the period of realizing the two centenary goals ; Second, from the perspective of research methods, existing research is mainly based on the traditional generational overlap model and the improved general equilibrium model, but there are not many calculable simulation methods that fully consider the Chinese context and can simulate future capital returns in China over the years ; Third, from the perspective of research content, although most studies have found that changes in population structure may have a negative impact on capital returns, even Ikeda and Saito , Zhao Jian and others further explored the mechanism of avoiding this negative impact have been explored, but not much has been done exploring the capital gains effects of fertility policies in response to aging. In order to improve the deficiencies of the existing literature, this study fully considers the Chinese context, establishes a capital endogenous nonlinear dynamic optimization model that can simulate the impact of future population structure changes on capital income interest rates, and attempts to answer the question of future capital in the context of aging. Scientific issues such as whether the interest rate of income has entered a downward channel and whether the birth policy can change the trend characteristics of future capital income interest rates.

2 MODEL AND PARAMETER SETTING

2.1 Basic Model

Referring to the research of Barro and Becker [15] and Yang Hualei [16], this paper establishes a dynamic optimization model for the labor force to make decisions in each period. The elderly population, youth population, labor force, total output and wages of period i are denoted as Oi, Hi, Li, Yi and Wi respectively, social savings and consumption are denoted as Si and C respectively, social pension insurance contribution rate and personal pensioniinsurance The contribution rates are denoted as τ 1 and τ2 respectively, the proportions of supporting the elderly and raising children to wages are respectively Xiao and μ, and the total output Yi in period i is used for consumption C, saving Si, raising children Hi μWi , and supporting the elderly iWi Oi, the basic pension τ 1 Li Wi paid into the social pooling account, and the personal account pension τ2 Li Wi various expenditures, then there are:

$$Yi = C \overset{1}{i} + Si + Hi\ \mu Wi + Oi\ Small\ Wi + \tau\ 1\ Li\ Wi + \tau 2\ Li\ Wi \quad (1)$$

If the i-th period of saving, raising children, supporting the elderly, and the return of the social pension insurance paid are recorded as $C \overset{2}{i}$, the intertemporal substitution elasticity, the discount coefficient of future consumption, and the weight coefficients of raising children and supporting parents are respectively recorded here as σ, β, γ, and χ. Referring to the setting of the exponential objective function of Barro and Becker (1989), the total utility obtained by the working population in period i is:

$$Ui = (C \overset{1}{i})\ \sigma + \gamma\ (Hi\ \mu Wi)\ \sigma + \chi\ (Oi\ Wi)\ \sigma + \beta\ (C \overset{2}{i})\ \sigma \quad (2)$$

How much return will be brought in period i + 1 by saving, raising children, supporting the elderly and paying social pensions in period i?

To sum up, the decision-making faced by the working population in each period is how to allocate the output of each period among savings, consumption, maintenance, support and social pensions to maximize the utility of each period of output. In order to answer the impact of population aging on future capital returns in each period, the production sector needs to be introduced next. If the human capital level, total factor productivity and capital contribution share in the production sector are recorded as hi, α and A respectively, and the production function is a Cobb-Douglas production function with constant returns to scale, then:

$$Yi = A\ (Ki)\ \alpha\ (hi\ Li)\ 1\text{-}\alpha \quad (3)$$

According to the profit maximization condition of the production department, that is, capital factors and labor factors are paid according to the marginal cost of the corresponding output, then:

$$Wi = A(1\text{-}\alpha)\ (Ki)\ \alpha(hi\ Li)\text{-}\alpha$$

$$Wi + 1 = A(1\text{-}\alpha)\ (Ki + 1)\ \alpha(hi + 1\ Li + 1)\text{-}\alpha \quad (4)$$

$$ri + 1 = A\alpha(Ki + 1)\ \alpha\text{-}1\ (hi + 1\ Li + 1)\ 1\text{-}\alpha$$

How to determine the capital stock in each period? The capital stock in the i-th period is equal to the capital stock in the previous period minus the depreciation amount. If all savings and personal account pensions are used for investment, the savings in the previous period need to be added and personal account pension

Assuming that the depreciation rate of capital stock in each period is δ, then the capital stock in period i is:

$$Ki = (1\text{-}\delta)\ Ki\text{-}1 + Si\text{-}1 + \tau 2\ Li\text{-}1\ Wi\text{-}1 \quad (5)$$

How to calculate human capital? Based on the work of Barro and Lee [17], the level of human capital is a function of the number of years of education si. To make the human capital level equal to 1 in the initial year, set hi = e φ(si)-φ(s2015). At the same time, considering the higher return of early education, referring to the work of Lu Yang and Cai Fang [18], there are:

$$\varphi(si) = \begin{cases} 0.134^{*}\ (4\text{-}si), & si \leq 4 \\ 0.134^{*}\ 4 + 0.101^{*}\ (si\text{-}4), & 4 < si \leq 8 \\ 0.134^{*}\ 4 + 0.101^{*}\ 4 + 0.068^{*}\ (si\text{-}8), & si > 8 \end{cases} \quad (6)$$

2.2 Parameter Setting

Through the above dynamic optimization model equation (9), if the parameters in the model are known, this paper can use the equation to simulate the impact of future aging and childbirth policy adjustments on future capital returns in each period. By consulting relevant policy documents and scholars' research, the setting of each parameter and initial variable setting are shown in Table 1.

Table 1 Benchmark parameter setting

parameter	set value	in accordance with
Initial capital stock K2015 (billion yuan)	1038802	Based on the work calculation of Li Bin and Zeng Zhixiong (2009) [19]
Intertemporal substitution elasticity σ	of 0.85	Referring to the work of Yang Hualei (2019)

Discount factor β	0.95	Refer to the setting of Kang Chuankun and Chu Tianshu [20]
Weight factor assigned to child support expenditures γ	0.9	Based on the work of Peng Haoran et al. [21]
The weight coefficient χ assigned to the expenditure on supporting the elderly	0.8	Based on the work of Yang Hualei et al. [22]
Dependency coefficient μ	0.8	Based on the calculation of Liao [23]
The family support factor is small	0.6	Based on the target replacement rate
Basic pension contribution ratio τ 1	0.2	Based on enterprise pension insurance payment rate
Personal account pension contribution ratio τ2	0.08	Based on the personal account payment rate
Capital Contribution Share α	0.5	Based on Zhu et al. [24] work
The survival rate of the retired population πγ	0.994	Calculate the average survival rate of the population aged 55 and over based on the Sixth Census data
Total Factor Productivity A	0.015	Obtained by calibration of initial parameter values, it is total output divided by factor contribution
Capital depreciation rate δ	0.05	Referring to the work of Chen Changbing [25]

3 RESULTS AND ANALYSIS

According to the realistic and feasible parameters, after using the fmincon function of nonlinear optimization in the Matlab toolbox to carry out numerical simulation research, the following results are obtained in this paper: First, before 2050, which is the critical period for realizing the two centenary goals, with the population With the change of generations and the deepening of the aging population in the future, the future real capital income (taking 2015 as the constant price) will approximately present an L-shaped downward trend. Second, during the first 100-year goal realization period, before 2022, capital gains show a sharp downward trend; during the second 100-year goal realization period, between 2022 and 2050, capital gains show a slow downward trend. The above results mean that between 2015 and 2050, with the aging of the population, asset prices will show a downward trend year by year, capital gains (real interest rates) or personal savings income will enter a downward channel, and personal account pensions will face difficulties. Risk of appreciation or preservation of value.

Why does the capital income enter the downward channel in an aging society? This is because in the future with the arrival of an aging society, according to the capital income formula ri + 1 = Aα (hi + 1) 1-α(Li + 1 / Ki + 1) 1-α , the number of working-age population Li + 1 decreases or the growth rate slows down.

The stock Ki + 1 shows an increasing trend year by year because the amount of newly added capital is greater than the amount of depreciation, resulting in a decrease in the labor-capital ratio Li + 1 / Ki + 1; The high human capital brought by the labor force leads to a slight increase in the level of human capital, but the increase in human capital is not enough to compensate for the negative impact of the sharp increase in the capital-to-labor ratio, so capital returns show a downward trend.

4 FURTHER DISCUSSION

4.1 Sensitivity Analysis of Parameters

In order to ensure the internal validity of the above conclusions, this paper will conduct a sensitivity analysis on the child-rearing right coefficient γ, the pension proportion coefficient τ 1 of the pooling account, the discount factor β, and the intertemporal substitution elasticity σ. In order to ensure the reliability of the sensitivity analysis, considering that the intertemporal substitution elasticity σ and the discount factor β are usually less than 1, the value range of the intertemporal substitution elasticity σ is selected to be 0.25-0.95, and the discount factor The value range is from 0.35 to 0.99, and the interval

is 0.1, and 8 scenarios are set according to the interval and interval; considering that the weight coefficient γ assigned to the child-raising expenditure is greater than 0, here we set γ 8 scenarios of 0.2, 0.4, 0.6, 0.8, 0.9, 1.0, 2.0 and 4.0; under the condition that the total social pension payment ratio remains unchanged, considering China's future pension system reform is moving in the direction of the funded pension system, and the pooled payment ratio τ 1 is set to 5 scenarios, including 0.25, 0.2, 0.15, 0.10, and 0.05. The values of the parameters σ, β, γ and τ1 in the baseline scenario are 0.85, 0.95, 0.9 and 0.20 respectively, and the baseline scenario is marked with a thick line: First, different intertemporal substitution elasticities σ It does not affect the trend characteristic of capital income decline, but it will affect the absolute value of capital income; the greater the intertemporal substitution elasticity, the lower the capital income. Second, different discount factors β not only affect the trend characteristics of capital gains, but also affect the absolute amount of capital gains. Generally speaking, the smaller the weight given to future consumption, the higher the capital income and the more likely it will show an upward trend. The critical point of the discount factor for whether future capital income will rise or fall is around 0.75, which is higher than this critical point. If the value is lower than this critical value, the future capital income will show an upward trend, and the discount factor is usually around 0.9, so the future capital income will show a downward trend. Third, the weight coefficient γ assigned to child-rearing expenses not only does not affect the trend characteristics of capital returns, but also does not affect the absolute value of capital returns. Fourth, the contribution ratio τ 1 of the pooled account pension insurance also does not affect the trend characteristics of capital returns, but it will affect the absolute value of capital returns. Generally speaking, the higher the pension insurance contribution ratio of the pooled account, the lower the capital gains.

4.2 Adjustment Effect of Birth Control Policy

Considering that the aging of the population will lead to a downward trend in future capital gains, the simple reform of the funded pension system will increase the personal account pension, thereby increasing the capital stock, but at the same time reducing the capital stock, it will reduce the individual Therefore, the reform of the funded pension system is not effective. Then, in addition to the reform of the pension system, what is the effect of the adjustment of the birth policy in response to the decline in capital income under aging, and can it change the trend characteristics of future capital income? To answer this scientific question, this paper sets up two Fertility scenarios, namely the baseline scenario (Baseline scenario, referred to as BS) and hypothetical scenario (Hypothetical scenario, referred to as HS). Having the same fertility level in the future and the current one is the baseline scenario, and the hypothetical scenario is a high-fertility scenario. Let the fertility level in the hypothetical scenario be the fertility level at which people follow the universal two-child policy.

After further numerical simulation through equation (9), this paper finds that the capital income under the adjustment of the fertility policy (HS) is higher than the capital income under the unchanged fertility policy (BS), and the fertility policy changes the trend of future capital income decline, Especially around 2035, the return on capital will decline sharply again under the same birth control policy, but the return on capital will show an upward trend under the adjustment of birth control and maintain at a relatively high level. Analyzing the reason, it can be seen from the formula ri + 1 = Ai + 1 α (hi + 1) 1-α(Li + 1 / Ki + 1) 1-α that, compared with the low fertility scenario, more births not only increase future labor The population size reduces the ratio of capital to labor, increases the return on capital, and at the same time increases the human capital level hi + 1 and total factor productivity Ai + 1 of the future working population.

5 CONCLUSIONS AND POLICY IMPLICATIONS

In the critical period of realizing the two centenary goals, what trend will China's capital gains show, and will it enter the downward channel as previous scholars have found based on national sample studies from all over the world? If so, how should China avoid it in the future, and the focus of policy Where? Adhering to the principle of answering these key scientific questions, this paper attempts to establish a dynamic optimization framework for endogenous capital that can simulate the impact of

aging and public policy adjustments on capital returns over the years. According to realistic and feasible parameters, it is found after numerical simulation , before 2050, China's real capital gains will show an L-shaped trend feature, which means that in the critical period of realizing the two centenary goals, real capital gains may enter a downward path. The internal mechanism is that population aging increases the future capital-labor ratio, thereby reducing capital returns. The above conclusions remain stable under changes in parameters such as intertemporal substitution elasticity, child-rearing consumption weighting, and pension system reform, but they show different characteristics for changes in the discount factor. In order to change this trend feature, this paper further simulates the impact of the adjustment of the birth policy on future capital returns and finds that: the future capital returns under the high birth rate scenario are not only higher than the capital returns under the same birth policy, but the high birth rate scenario will also change The trend of future capital income decline; especially after 2035, compared with the low birth rate scenario, capital income will once again show a cliff-like decline trend, but the high birth rate scenario has greatly reversed this trend, making capital income present rising trend and maintained at a high level.

The above research means that during the critical period of realizing the two centenary goals, China's investment environment may be in an unfavorable situation, and there is a risk of capital outflow. The reduction in savings rate and capital outflow under aging may make the capital engine that promotes China's economic growth Insufficient motivation; Moreover, extremely low capital gains mean that people are more willing to keep money in their hands than to invest, and monetary policy is ineffective in regulating the macroeconomy; at the same time, under the funded system, the income of social pensions in personal accounts is extremely low, and pensions enter the market Investment may not be able to obtain higher capital returns. Under the aging population, the funded pension system is not a panacea. Although people have money and savings in the future, savings and personal account pensions face the risk of not being able to appreciate and maintain their value. To sum up, in order to reverse the trend of declining capital income in the future, enhance the capital engine that will drive China's economy forward in the future, improve the effectiveness of monetary policy, ensure the appreciation and preservation of pensions, and enhance the effectiveness of the reform of the funded pension system in the future, The focus of current public policy can be on raising fertility levels.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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