A Study on the Optimal Contribution Rate for Pension Pooling Accounts Considering State-Owned Enterprise Profits

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Abstract

This paper investigates the problem of optimal contribution rates for pension pooling accounts, treating contributions to these accounts as social security tax, and constructs an optimal contribution rate model under the condition of supplementing pension pooling accounts with profits from state-owned enterprises. Through this model, it analyzes the optimal contribution rate for pension pooling accounts and derives the corresponding optimal contribution rates for different proportions of state-owned enterprise profits allocated to pension payments. The results indicate that: under the scenario where residents' assets are entirely allocated to consumption, while maintaining the current insured population and without considering state-owned enterprise profits, the optimal contribution rate for 2018 is 15.27%; when 10% of state-owned enterprise profits are utilized for pension budget balance, the optimal contribution rate is 13.67%. If universal coverage is achieved, without considering state-owned enterprise profits, the optimal contribution rate for 2018 is 12.58%; when 10% of state-owned enterprise profits are utilized for pension budget balance, the optimal contribution rate is 11.04%. We also examine the scenario in 2050 when China' s population aging intensifies: without considering delayed retirement, the pension contribution rate for the pooling account is 28.62%; if retirement is delayed to age 65, the pension contribution rate is 15.47%; if 10% of state-owned enterprise profits are used to supplement the pension pooling account, the pension contribution rate can be reduced to 13.79%. These findings reveal that China' s pension system has certain room for improvement.

Full Text

Preamble

Research on the Optimal Contribution Rate of the Pension Pooling Account Considering State-Owned Enterprise Profits

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Abstract

This paper investigates the optimal contribution rate for the pension pooling account by treating contributions as a social security tax and constructing an optimal contribution rate model that incorporates state-owned enterprise (SOE) profits into the pension pooling account. Through this model, we analyze the optimal contribution rate for the pension pooling account under different scenarios where varying proportions of SOE profits are allocated to pension payments. The results indicate that when residents consume all their assets, maintaining the current insured population, and disregarding SOE profits, the optimal contribution rate for 2018 is 15.27%. When 10% of SOE profits are used for pension budget balance, the optimal contribution rate becomes 13.67%. If universal coverage is achieved, the optimal contribution rate for 2018 is 12.58% without considering SOE profits, and 11.04% when 10% of SOE profits are allocated to pension balance. We also examine the scenario in 2050 when China' s aging population intensifies. Without delayed retirement, the pension contribution rate for the pooling account would need to be 28.62%; with retirement delayed to age 65, the rate drops to 15.47%; and if 10% of SOE profits supplement the pension pooling account, the contribution rate can be further reduced to 13.79%. These findings suggest that China' s pension system has room for improvement.

Keywords: Pension pooling account; Optimal contribution rate; State-owned enterprise profits
JEL Classification: E20; H55; E12

1. Introduction

The outbreak of COVID-19 in 2020 delivered a massive shock to the global economy, particularly affecting small and medium-sized enterprises. Many businesses fell into severe difficulties. As the Chinese government implemented various proactive measures and the entire population cooperated effectively, COVID-19 has been brought under control in China, and businesses have gradually recovered. However, the pandemic remains in an explosive phase abroad, leaving Chinese enterprises facing enormous external risks. External demand will require considerable time to return to normal, and businesses continue to face significant uncertainty. How to restore enterprise vitality, reduce their burden, and help them survive this crisis has become an issue we must confront.

During this period, the government has implemented numerous countermeasures, such as tax reductions for enterprises, providing certain subsidies, and deferring social security contribution payments. These measures have substantially alleviated enterprise burdens, yet we believe some could be further optimized. For instance, while social security contributions have been deferred, they must eventually be paid. Could we reduce enterprise burdens by lowering social security contribution rates? Our answer is affirmative.

China' s current social security contribution rates, particularly for pensions, remain excessively high. Before 2019, the pension pooling account contribution rate was 20%; in 2019, the Chinese government adjusted it to 16%, but it remains relatively high. A global enterprise tax burden report released by PwC and the World Bank (2016) supports this view. The report examined enterprise tax burdens across different countries and regions using three indicators: total tax rate, time required to pay taxes, and number of tax payments. China' s total enterprise tax burden ranked second in the Asia-Pacific region, only behind Palau, at 67.8%—higher than major developed countries such as the United States (51.7%), the United Kingdom (32%), and Germany (48.8%). China' s enterprise tax burden comprises 10.8% income tax and 8.5% other taxes, which are moderate, but labor-related taxes reach 48.1%, the highest in the Asia-Pacific region—exceeding Sweden (39.4%), a Nordic welfare state, and the United States (25.4%). This demonstrates that China' s enterprise tax burden is indeed heavy, particularly due to high social security contribution rates [1].

To alleviate enterprise burdens, the Chinese government adjusted the enterprise pension contribution rate from 20% to 16% in 2019. To compensate for losses to the pension pooling account, the government transferred 10% of state-owned enterprise shares to the social security fund, thereby ensuring the sustainability of the pension system. Key questions arise: Is the adjusted contribution rate reasonable? Is there still room to reduce the current rate? What is the relationship between using SOE profits for pension payments and the optimal pension contribution rate? Additionally, as China' s population aging intensifies, how can we solve the future sustainability problem of our pension system?

Therefore, this paper attempts to study the optimal contribution rate for China' s current pension pooling account under different conditions, as well as the optimal rate for the pooling account in 2050 when aging becomes severe, providing relevant policy recommendations for the sustainable development of China' s pension insurance system.

2. Literature Review and Research Framework

Research on pension insurance has consistently been a hot topic in academic studies. Pension insurance occupies the largest share of China' s social security system. With increasing life expectancy and intensifying population aging, China is gradually entering an aging society, and the sustainability of its pension system faces enormous challenges. Guo Yongbin (2013) established an actuarial model for pension funding gaps, estimating that China' s pension system would begin showing deficits in 2025 (61.8 billion yuan), peaking at 8 trillion yuan in 2054, then declining to a minimum of 4.9 trillion yuan by 2089, before rising again to 7.5 trillion yuan in 2111. The deficit increases with higher pension replacement rates and adjustment indices, while decreasing with higher contribution rates [2]. Other scholars such as Ai Hui et al. (2012), Qian Zhenwei, Bu Yi, and Zhang Yan (2012), and Wang Xiaojun and Ren Wendong (2013) have reached similar conclusions based on actuarial models [3-5].

Regarding China' s pension insurance issues, many domestic scholars have conducted research from an economic perspective. Yuan Zhigang and Song Zheng (2000) used a two-period overlapping generations (OLG) model to examine population age structure, pension insurance systems, and optimal savings rates, concluding that China' s current savings rate does not reflect the socially optimal savings rate and that reducing the savings rate could constitute a Pareto improvement [6]. Feng Jin (2004) studied China' s pension system from a welfare economics perspective, demonstrating that when a country' s wage growth rate plus population growth rate exceeds the investment return rate, or when income inequality is substantial, a pay-as-you-go system benefits overall social welfare, and subsequently examined the optimal contribution rate [7]. Zeng Yi (2005) found that population aging creates enormous gaps in rural pension security expenditures, indicating that the rural pension insurance system urgently needs improvement [8]. Li Min and Zhang Cheng (2010) calculated that under the existing pension security system, the reasonable proportion of China' s pension expenditures to GDP should have been 3.63% in 2006, and predicted future reasonable levels of pension expenditures based on demographic trends [9]. Wang Lijian (2010) measured the impact of population age structure changes on pension security expenditures from the perspective of residents' actual pension security needs [10]. Kang Chuankun and Chu Tianshu (2014) constructed a general equilibrium OLG model to estimate the optimal social pooling contribution rate for a unified national pension insurance system, examining the impact of population aging. They found the optimal pooling contribution rate ranges between 10.22%-19.04%, lower than China' s 20% social pooling contribution rate [11]. Gong Feng and Yu Jinliang (2015) examined population aging, tax burden, and fiscal sustainability, proposing that extending retirement age, supporting the development of elderly care industries, and improving social pension security levels to enhance consumption capacity and willingness among the elderly are important approaches to improving fiscal sustainability in an aging society [12].

Internationally, pension insurance represents a classic intergenerational issue. The overlapping generations model was first proposed by Samuelson (1958) when studying rational consumers' consumption-savings patterns throughout their lives [13]. Diamond (1968) improved the OLG model based on this work when examining national debt issues in neoclassical growth models [14]. Numerous scholars subsequently built upon this foundation. Auerbach and Kotlikoff

(1987) improved the two-period OLG model by selecting 55 years as the time span, assuming residents live only two periods—adulthood and old age—entering adulthood at age 21 and dying at 75. Childhood support costs are abstracted as a burden during adulthood, with adult and elderly residents coexisting each year [15]. Feldstein (1985, 1987) first applied the two-period OLG model to pension system design, constructing a social welfare function comprising the utility of working residents and retired residents, deriving the optimal pension contribution rate through social welfare maximization. The author also discussed the impact of rational and myopic residents on pensions and established a unified optimal pension plan with optimal contribution rates [16-17]. Borck (2007) proposed a model where public pensions are determined by voting based on different income and age factors, noting that when income declines, high pension contribution rates are favored by low-income workers and pensioners, while when income rises, they are favored by high-income workers and pensioners [19]. Cremer et al. (2008) studied optimal pension mechanisms in societies comprising rational and myopic residents, introducing paternalistic welfare functions, considering flexible labor supply, wage heterogeneity, and mandatory savings conditions. From a social planner' s perspective, they conducted detailed analyses of pension systems, noting that rational and myopic residents share the same ex post intertemporal preferences, with only rational agents making savings decisions based on these preferences. Rational residents also exhibit higher productivity, and social welfare functions depend on ex post utility. The scale and extent of myopic residents' pension systems affect redistribution, with transitions between the proportion of myopic residents and pension system characteristics being considerably more complex. The authors also provided optimal pension contribution rates [19]. Simonovits (2010) introduced an optimal contribution rate with an appropriate upper limit on pension contributions (or their base), excluding income above the limit from the contribution base within an OLG framework. In this model, the government operates a mandatory proportional pension system to substitute low life-cycle savings of low-income, short-sighted workers while maintaining incentives for high-income, far-sighted workers to contribute to the system, thereby increasing the optimal contribution rate, helping more low-wage myopic workers, and reserving sufficient savings space for high-wage far-sighted workers. The findings indicate that social welfare is almost independent of the upper limit across a wide range, but maximum welfare is 0.3-4.5% higher than welfare without an upper limit [20]. Fehr, Kallweit, and Kindermann (2012) examined German pension insurance system reforms using a general equilibrium approach, concluding that the German government must implement delayed retirement; otherwise, the contribution rate would reach 26% by 2040. Only by delaying retirement age to 67 can Germany ensure the sustainability of its pension insurance system [21]. Garon (2015) used a two-period OLG model to study the importance of government commitment to prefunded pension systems, noting that a fully funded system helps the government maintain its initial optimal decisions [22]. D' Elia (2016) employed an overlapping generations model to study optimal redistribution and contribution rate issues between pensions for heterogeneous residents with formal and informal employment in Argentina, noting that redistribution at earlier times is superior to later redistribution, and higher redistribution rates help narrow gaps between different residents [24]. Fehr, Kallweit, and Kindermann (2017) used an overlapping generations model to examine the impact of changing family structures on pension funds, concluding that because higher labor market distortions dominate the self-insurance effects of home production, home production reduces long-term welfare gains and increases efficiency losses in pension funds. Dual-income families positively affect pension fund efficiency by providing family insurance [25]. Peris-Ortiz et al. (2020) analyzed the sustainability of pension systems in developed countries and their challenges from three perspectives: demographic changes, labor market mobility, and risk sharing [26].

The pension contribution rate is essentially an optimal taxation problem. Farhi et al. (2012) considered information asymmetry between the government and individuals, applying dynamic game methods to use the overlapping generations model for optimal capital taxation research [27]. Saez and Stantcheva (2016) conducted in-depth research on optimal tax theory, proposing the use of generalized marginal social welfare weights to evaluate tax reforms [28]. Fleurbaey and Maniquet (2018) studied optimal tax theory from a fairness perspective [29]. Kasy (2018) examined optimal taxation and social insurance systems from a machine learning perspective [30].

Through analyzing the above literature, we find that when studying pension systems, some approaches use actuarial methods to establish models for determining optimal contribution rates. The limitation of this method is that it fails to consider macroeconomic factors and overlooks the core role of enterprises in the pension insurance system.

The mainstream method in current literature for studying pension contribution rates primarily relies on two-period OLG models, where current retirees' pensions derive from a portion of wages of young, working residents—meaning the current generation of young people supports the current generation of retirees. However, this treatment does not align with reality. Many countries worldwide (including China) treat pension contributions as a tax levied on enterprises. For instance, the Chinese government has transferred pension collection to the tax authority, which collects contributions from enterprises. In 2019, China reduced the pension pooling account contribution rate from 20% to 16%, but the saved 4% was not distributed to workers as wages; instead, it remained with enterprises as a profit source. This represents a de facto tax reduction, as many enterprises—especially private ones—currently pay pension pooling account contributions based on 50% of basic wages (as permitted by the state). The Chinese government reduces enterprise tax burdens and enhances competitiveness by lowering pension contribution rates. Under the approach where current workers support retirees, reducing enterprise pension contribution rates cannot reduce enterprise tax burdens, because the reduced portion would be distributed to workers as wages. Therefore, using OLG models to handle pension pooling account contribution rates becomes inappropriate. Consequently, this paper no longer treats pension insurance as an intergenerational issue but rather as an optimal taxation problem.

Second, China' s economic system differs from Western countries. As a socialist nation, China employs a combined public and private ownership system with public ownership playing the dominant role. China possesses substantial state-owned enterprises and state assets, with returns from these SOEs and assets belonging to the state and, by extension, all citizens. The government' s role in China' s economic system also differs from Western capitalist countries, where governments play the role of night watchmen. The Chinese government is entirely different—it not only provides public goods but also serves as a crucial participant in the overall economy. The government considers not only residents' (the people' s) utility and pursues their utility maximization but also must provide necessary public goods. The more and better public goods provided, the more satisfied the people become, and the stronger the government' s willingness to provide them. As General Secretary Xi Jinping stated in the 19th Party Congress report: "Never forget why you started, and you can accomplish your mission. The original aspiration and mission of Chinese Communists is to seek happiness for the Chinese people and rejuvenation for the Chinese nation." This reaffirms that the Communist Party of China is the vanguard of the Chinese people and the Chinese nation, always remembering its glorious mission and historical responsibilities— "serving the people," the five golden characters inscribed on the red wall of Xinhua Gate in Zhongnanhai, representing the Party' s purpose and original aspiration, consistent from beginning to end. The Chinese government, led by the Communist Party of China, aims to satisfy the people' s aspirations for a better life. This demonstrates that our government differs from Western governments: it actively provides public goods to residents and serves as an important economic participant. Traditional Western macroeconomic models no longer suit our country; we need to construct economic models appropriate for China' s national conditions. Finally, China' s pension system differs from Western capitalist countries in that we can use SOE profits to balance the pension pooling account, taking from the people and using for the people to pursue optimal social welfare.

Based on the above analysis, this paper employs a multi-period household utility model based on general equilibrium to study China' s optimal pension contribution rate, treating the pension contribution rate as an optimal taxation problem. The optimal pension contribution rate involves several key macroeconomic participants. First, residents work and receive wages, which they allocate between consumption and investment to form assets that generate rental income. Upon retirement, residents receive pensions (including individual accounts and pooling accounts; we do not consider individual accounts). Residents make consumption, work, and investment decisions based on expected pension benefits. Enterprises are providers of pooling account pension contributions, making decisions according to profit maximization principles. The government is responsible for the pension pooling account, owns state-owned enterprises, and pursues both resident utility and its own utility maximization. These three parties each pursue their optimal decisions. When making pension decisions, the government plays two roles: first, as a macroeconomic participant providing public goods, using SOE profits for pension pooling account payments, with the optimal decision resulting in a balanced pension pooling account (zero pension payment gap); second, as a social planner determining the optimal pooling account contribution rate through household welfare maximization.

This paper makes three contributions: First, we are the first to incorporate SOE profits into the pooling account and provide an analytical solution for the optimal contribution rate, theoretically clarifying the relationship between them. Second, we construct an optimal model for three parties—residents, enterprises (distinguished as SOEs and private enterprises), and the government—tailored to China' s macroeconomic context. This fully considers the specific characteristics of China' s socialist system, including state-owned assets, SOEs, and their formation, effectively resolving the contribution rate issue when SOE profits are used for the pooling account. Third, our approach differs from traditional OLG models that treat pension pooling account contributions as current workers' wages supporting retirees and future workers' wages supporting current workers. Instead, our treatment addresses China' s specific reality by viewing pension contributions as a social security tax paid by enterprises.

3. The Model

In China' s pension system, there are three parties: residents, enterprises, and the government. We divide enterprises into state-owned and private enterprises, which are independent of each other. Working residents provide labor to enterprises, receive wage income, allocate wages between consumption and investment to form assets, and earn income from asset rentals. Upon retirement, residents receive pensions to maintain normal living standards. Residents weigh consumption against investment to maximize their utility. Enterprises rent residents' assets for production, pay wages to individuals, earn profits, and contribute to pension insurance for workers. Enterprises are rational and aim to maximize profits. The government provides public goods, with revenue sources including taxes and returns from state-owned enterprises. The government weighs future investment against current expenditures to maximize both its own utility and residents' utility. Additionally, as a social planner, the government balances welfare across age groups, ensures decent living standards for retirees, and promotes social stability and harmony.

3.1 Residents

We categorize residents (focusing on urban residents) into young and elderly. Young residents are those who work before retirement; elderly residents are those who have retired. At any time t, the population structure in the pension system consists of $N_{t,0}, N_{t,1}, ..., N_{t,k}, ..., N_{t,J_R}, ..., N_{t,J_D}$, where $N_{t,k}$ represents the number of people who have worked for k years in year t, also indicating participants' economic lifespan. J_R denotes retirement age, and J_D denotes the time of death for elderly system participants, which could be a random variable. For simplicity, we assume it is a deterministic integer, with each resident living to time J_D with probability 1. We divide the economy' s population into total population, working population, and retired population, expressed as:

$$N_t = \sum_{k=0}^{J_D} N_{t,k}, \quad N_t^W = \sum_{k=0}^{J_R-1} N_{t,k}, \quad N_t^R = \sum_{k=J_R}^{J_D} N_{t,k}$$

where N_t represents total population, N_t^W represents working population, and N_t^R represents retired population.

In this system, at time t, young residents of age k decide whether to provide labor based on consumption utility each period. If they provide labor, they receive nominal wage $W_{t,k}$. They can choose to consume it or allocate part to investment. Their current consumption is denoted by $C_{t,k}$, and current investment by $I_{t,k}$. Residents, whether consuming or investing, are rational agents pursuing utility maximization. Therefore, we introduce the resident utility function:

$$U_{t,k} = \sum_{s=k}^{J_D} \beta^{s-k} u(C_{t+s-k,s}, L_{t+s-k,s})$$

$$U_t = \sum_{k=0}^{J_D} N_{t,k} U_{t,k}$$

where β is the discount factor, $U_{t,k}$ represents the utility of an individual aged k at time t, and U_t represents residents' total expected utility.

In equation (3), φ represents the inverse elasticity of labor supply to real wages, $L_{t,k}$ represents the amount of labor residents are willing to supply at time t, and $C_{t,k}$ represents consumption of residents aged k in year t.

Residents do not use all income for consumption but allocate part to investment to form physical and financial assets, earning rental income from physical assets. We assume financial assets are held as government bonds earning investment returns. Therefore, residents' budget constraint is:

$$P_t C_{t,k} + P_t I_{t,k} + B_{t,k} + P_t^K K_{t,k} = W_{t,k} L_{t,k} + (1+i_{t-1}) B_{t-1,k-1} + P_t^K R_t^K K_{t-1,k-1} + D_{t,k} - T_{t,k} + P_t^P \Phi_{t,k}$$

where $L_{t,k}$ represents effective labor provided to enterprises, from which residents receive wage income. $B_{t,k}$ represents residents' financial assets, one-period government bonds with price P_t^B. P_t represents the price level. $K_{t,k}$ represents residents' physical assets. R_t^K represents the rate of return residents earn from renting out assets. $D_{t,k}$ represents dividends residents receive from holding stocks of imperfectly competitive intermediate goods companies, distributed according to the proportion of assets (capital) provided to private enterprises, specifically:

$$D_{t,k} = \frac{K_{t-1,k-1}}{K_{t-1}^P} \Pi_t^P$$

where $I_{t,k}$ represents residents' investment. $T_{t,k}$ represents taxes paid by residents, which we treat as lump-sum taxes here. $P_t^P \Phi_{t,k}$ represents pensions received by residents, referring to government-paid pensions (pooling account) in this paper, which we will specify when deriving the optimal contribution rate.

We assume residents begin with zero assets ($K_{t,0} = 0$) and die with zero assets ($K_{t+J_D,J_D} = 0$), meaning residents not only consume pensions during retirement but also gradually deplete their assets for consumption, leaving no bequests to descendants.

When residents invest, they form stock assets that are rented to production firms to earn capital rental income $R_t^K K_{t,k}$. Therefore, residents' capital evolution satisfies:

$$K_{t,k} = (1 - \delta^K) K_{t-1,k-1} + I_{t,k} - S(I_{t,k})$$

where δ^K is the depreciation rate of residents' physical assets, $K_{t,k}$ represents residents' assets, and $I_{t,k}$ represents residents' investment. $S(\cdot)$ is a positive investment adjustment cost function.

When constructing our OLG model for residents, we follow the treatment in Vogel (2014) and Eggertsson, Mehrotra, and Robbins (2019) [31-32]. General literature typically uses two-period models for OLG frameworks, which are convenient for theoretical research but less practical for empirical applications, making multi-period models more useful. Additionally, while our OLG model is formally similar to traditional ones, it is substantively different: residents no longer allocate a portion of wages to the pooling account; instead, the pooling account' s funding source is the social security tax paid by enterprises.

3.2 Government

The government plays a crucial role in China' s national economy. According to our country' s nature, the government pursues maximization of the broad masses' interests and its own utility maximization in economic life. Government expenditures are constrained by numerous factors. Government revenue includes not only tax income but also substantial state-owned assets generating enormous returns annually. Therefore, the government' s budget constraint is:

$$P_t G_t + P_t I_t^G + B_t + P_t^P G_t^R = T_t + P_t^K R_t^K K_{t-1}^G + \Pi_t^G + P_t^P \Psi_t$$

where G_t represents government expenditures. K_t^G represents government-owned stock assets. I_t^G represents government investment. $R_t^K K_t^G$ represents rent from government assets leased to SOEs. Π_t^G represents SOE profits. Ψ_t represents the pension pooling account payment gap, specifically:

$$\Psi_t = \theta\Pi_t^G + \tau W_t L_t - P_t^P \sum_{k=J_R}^{J_D} N_{t,k}\Phi_{t,k}$$

where θ represents the proportion of SOE profits used for pension balance, τ represents the proportion of pension contributions paid by enterprises to the pooling account, J_R represents pension payment years (or distribution coefficient), and L_t represents total labor provided by workers. Additionally, the government' s asset evolution equation is:

$$K_t^G = (1-\delta^G)K_{t-1}^G + I_t^G - S(I_t^G)$$

where δ^G is the depreciation rate of government physical assets, K_t^G represents government assets, and I_t^G represents government investment. $S(\cdot)$ is a positive investment adjustment cost function.

Under budget constraints, the government pursues both household utility maximization and its own utility maximization. The government' s optimization objective function is:

$$\max_{G_t, I_t^G, B_t, \tau, \theta} \sum_{t=0}^{\infty} \gamma^t \left[\omega \ln(C_t) + (1-\omega)\ln(G_t)\right]$$

where ω represents the government' s weight on residents, and its constraints include the government budget constraint (8), government asset evolution (10), and household constraints (6). In the optimization objective function (11), the government also pursues household utility maximization.

3.3 Enterprises

For simplicity, we assume only one type of competitive final product is produced. We divide enterprises producing intermediate goods into state-owned and private enterprises, each producing a portion, with SOEs and private enterprises being completely independent. We assume final goods production is perfectly competitive with zero profit, so we do not distinguish final goods production enterprises.

3.3.1 Intermediate Goods Production Intermediate goods are produced by firms consisting of SOEs and private enterprises that are independent of each other, using different technologies, renting different capital, and employing different workers. The SOE production function is:

$$Y_t^G = A_t^G (K_t^G)^{\alpha_G} (L_t^G)^{1-\alpha_G} - F^G$$

where K_t^G represents SOE assets, L_t^G represents labor employed by SOEs in intermediate goods production, and F^G represents fixed costs for SOE intermediate goods production. SOE-rented state capital is:

$$K_t^G = K_t^{G,\text{rent}}$$

SOE nominal profit is:

$$\Pi_t^G = P_t Y_t^G - W_t L_t^G - P_t^K R_t^K K_t^G - \tau W_t L_t^G$$

where τ represents the proportion of pension contributions paid by enterprises to the pooling account, and $R_t^K K_t^G$ represents rent for government assets leased by SOEs. In China, pooling account pension contributions are paid by enterprises as a certain proportion of wages paid to workers. SOE profit maximization conditions are:

$$\frac{\partial \Pi_t^G}{\partial L_t^G} = 0, \quad \frac{\partial \Pi_t^G}{\partial K_t^G} = 0$$

The private enterprise production function is:

$$Y_t^P = A_t^P (K_t^P)^{\alpha_P} (L_t^P)^{1-\alpha_P} - F^P$$

where K_t^P represents private enterprise assets, L_t^P represents labor employed by private enterprises in intermediate goods production, and F^P represents fixed costs for private enterprise intermediate goods production. Private enterprises rent residents' assets:

$$K_t^P = \sum_{k=0}^{J_R-1} K_{t,k}$$

Private enterprise nominal profit is:

$$\Pi_t^P = P_t Y_t^P - W_t L_t^P - P_t^K R_t^K K_t^P - \tau W_t L_t^P$$

where $R_t^K K_t^P$ represents rent for assets leased from residents. Private enterprise profit maximization first-order conditions are:

$$\frac{\partial \Pi_t^P}{\partial L_t^P} = 0, \quad \frac{\partial \Pi_t^P}{\partial K_t^P} = 0$$

Additionally, labor employed by SOEs and private enterprises is:

$$L_t = L_t^G + L_t^P$$

3.3.2 Final Goods Final goods are processed from intermediate goods. Final goods production enterprises are perfectly competitive. We denote final goods as Y_t, with the relationship:

$$Y_t = \left[\omega_G (Y_t^G)^{\frac{\epsilon-1}{\epsilon}} + \omega_P (Y_t^P)^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}}$$

where ϵ is the price markup for product production. Final goods producers' profit maximization first-order conditions are:

$$P_t^G = \omega_G \left(\frac{Y_t}{Y_t^G}\right)^{\frac{1}{\epsilon}} P_t, \quad P_t^P = \omega_P \left(\frac{Y_t}{Y_t^P}\right)^{\frac{1}{\epsilon}} P_t$$

where P_t^G and P_t^P represent intermediate goods prices.

3.4 Market Clearing and Equilibrium

Market clearing occurs when the expenditures, labor supply, asset allocation, investment, asset rentals, employment, and profits of residents, enterprises, and government satisfy the following conditions:

1. Residents maximize consumption utility subject to constraints (3), (4), (5), and (7)
2. Residents satisfy constraint (5), with assets satisfying $K_{t,k} \geq 0$
3. Residents receive intermediate goods profits distributed according to their capital (asset) investment proportion, given by equation (6)
4. Private and SOE output given by production functions (12) and (16), with total output given by equation (21)
5. Private and SOE profits given by equations (14) and (18)
6. Total population, working population, and retired population given by equation (2)
7. Total labor supply given by equation (20)
8. Private and SOE profit maximization first-order conditions given by equations (15) and (19)
9. Final goods producers' profit maximization first-order conditions given by equation (22)
10. Residents' and government' s asset evolution given by equations (7) and (10)

11. Government' s optimal utility function and constraints given by equations (11), (8), and (10)
12. Asset market clearing given by equations (13) and (17)
13. Pension gap covered by government. Since the government uses SOE profits for the pension pooling account, market clearing implies zero pension payment gap, given by equation (9)

3.5 Pooling Account Pension

To better address the enterprise pension contribution rate issue, we follow Kang Chuankun and Chu Tianshu (2014) by disregarding individual pension contributions to individual accounts, treating them as residents' personal investments for better consumption allocation. Therefore, when workers retire, their pensions come from the pooling account pension $P_t^P \Phi_{t,k}$. The pooling account pension is based on the average of the previous year' s average monthly wage of on-post workers and the individual' s indexed average monthly contribution wage, multiplied by the percentage of contribution years. We denote the contribution years percentage as λ, which is also the pooling account pension distribution coefficient. According to social security law, retirees' pensions must be appropriately adjusted based on overall social wage growth and inflation levels, expressed by function $f(\pi_t^w, \pi_t^p)$. For convenience, we simplify this as f_t. For the adjustment equation, we adopt the method proposed by Han Wei and Mu Huaizhong (2007) [33], which can be specifically expressed as:

$$f_t = (1 + \pi_{t-1}^w)^{\alpha_w} (1 + \pi_{t-1}^p)^{\alpha_p}$$

where π_{t-1}^w and π_{t-1}^p represent previous year' s real wage inflation and price inflation, respectively, i.e., $\pi_t^w = \frac{W_t}{W_{t-1}} - 1$ and $\pi_t^p = \frac{P_t}{P_{t-1}} - 1$, with lowercase w_t representing real wages and π_t^p representing inflation. Since adjustments occur annually, the cumulative adjustment coefficient is $f_{t,k} = \prod_{s=1}^{k} f_{t-s}$. We can thus define:

$$\Phi_{t,k} = \lambda f_{t,k} \frac{W_{t-1} + w_{t-1} \cdot \text{index}_{t-1}}{2}$$

where W_{t-1} is the social average wage in the year before retirement, and index_{t-1} is the individual contribution index, specifically calculated as:

$$\text{index}_{t-1} = \frac{\sum_{s=1}^{J_R} W_{t-s}}{J_R \cdot W_{t-1}}$$

To simplify our model for easier handling, we assume all workers contribute to pensions from starting work until retirement, making the contribution years ratio a parameter for all retirees, which we simplify as λ. In equilibrium, all residents make identical choices, so $\text{index}_{t-1} = 1$. The pooling account individual pension is:

$$\Phi_{t,k} = \lambda f_{t,k} W_{t-1}$$

3.6 Optimal Contribution Rate

As a social planner, the government does not make decisions directly for individual residents but changes residents' and enterprises' decisions by altering the enterprise pension contribution rate τ. We now introduce the social welfare function, treating it similarly to Farhi et al. (2012), but with residents living multiple periods rather than two:

$$\max_{\tau} \sum_{t=0}^{\infty} \gamma^t \sum_{k=0}^{J_D} \omega_k N_{t,k} U_{t,k}$$

subject to:

$$U_{t,k} = \sum_{s=k}^{J_D} \beta^{s-k} u(C_{t+s-k,s}, L_{t+s-k,s})$$

where ω_k represents the government's weight on residents of different generations, serving as a social discount factor. $C^*_{t,k}$ and $L^*_{t,k}$ denote optimal consumption and labor choices for individual residents. We now present the model' s optimal solution.

3.7 Optimal Solutions for Residents, Enterprises, and Government

Since the core task of this paper is to find the optimal contribution rate for the pension pooling account, we place the respective optimal solutions for residents, enterprises, and government in the appendix.

3.8 Optimal Contribution Rate for Pension Pooling Account

As a social planner, the government cares about every person in society, assigning different weights ω_k to each age group to pursue maximum social utility. It formulates government decisions based on optimal decisions by residents and enterprises. Therefore, in the government' s objective function (11), we substitute residents' optimal consumption and labor decisions, removing terms unrelated to the current period, which can be written as:

$$\max_{\tau} \sum_{t=0}^{\infty} \gamma^t \left[\sum_{k=0}^{J_R-1} \omega_k N_{t,k} u(C^*_{t,k}, L^*_{t,k}) + \sum_{k=J_R}^{J_D} \omega_k N_{t,k} u(C^*_{t,k}, 0) \right]$$

Substituting working residents' consumption:

$$C_{t,k}^{*} = C_{t,k}^{W} \quad \text{for} \quad k < J_R$$

and retirees' consumption:

$$C_{t,k}^{*} = C_{t,k}^{R} \quad \text{for} \quad k \geq J_R$$

In the government' s optimal decision, the pension gap is zero, so the pooling account pension can be written as:

$$P_t^P \sum_{k=J_R}^{J_D} N_{t,k}\Phi_{t,k} = \tau W_t L_t + \theta \Pi_t^G$$

In equation (33), we introduce the contribution years ratio λ because China' s pension distribution follows the principle of "more contributions, more benefits," requiring the introduction of the contribution ratio. The pension can also be written as:

$$\sum_{k=J_R}^{J_D} N_{t,k}\Phi_{t,k} = \lambda \sum_{k=J_R}^{J_D} N_{t,k} f_{t,k} W_{t-1}$$

For any age group' s pension, we have:

$$\Phi_{t,k} = \lambda f_{t,k} W_{t-1}$$

Thus we can obtain:

$$\sum_{k=J_R}^{J_D} N_{t,k}\Phi_{t,k} = \lambda W_{t-1} \sum_{k=J_R}^{J_D} N_{t,k} f_{t,k}$$

Substituting the above into the optimal objective function and taking the derivative with respect to τ, we can derive the first-order condition for the optimal value:

$$\frac{\partial \mathcal{L}}{\partial \tau} = 0$$

The terms $\frac{\partial C_{t,k}^{W}}{\partial \tau}$ and $\frac{\partial C_{t,k}^{R}}{\partial \tau}$ are given below, with lowercase letters representing real wages. This yields the pension contribution rate τ equation, but the solution form is extremely complex and requires simplification for empirical research.

Through further processing of the pooling account contribution rate and consolidating some parameters, we can derive the optimal pension pooling account contribution rate satisfying:

$$\tau_t^* = \frac{\lambda \sum_{k=J_R}^{J_D} N_{t,k} f_{t,k} \cdot \frac{W_{t-1}}{P_t} + \theta \frac{\Pi_t^G}{P_t}}{\frac{W_t}{P_t} L_t} \cdot \frac{1}{1+\epsilon_t}$$

where ϵ_t is:

$$\epsilon_t = \frac{\sum_{k=0}^{J_R-1} \omega_k N_{t,k} \frac{\partial C_{t,k}^W}{\partial \tau} + \sum_{k=J_R}^{J_D} \omega_k N_{t,k} \frac{\partial C_{t,k}^R}{\partial \tau}}{\sum_{k=0}^{J_R-1} \omega_k N_{t,k} \frac{\partial C_{t,k}^W}{\partial \tau} \cdot \frac{W_t}{P_t}}$$

In equations (39) and (40), N_t^{20+} represents all urban population aged 20 and above at time t, N_t^W represents all urban working population, N_t^R represents all urban retired population, and lowercase r_t represents real rental rates. In the above formulas, we divide both numerator and denominator by output Y_t, thus avoiding detrending of macroeconomic indicators. Moreover, as long as the economic structure does not undergo major changes, these economic ratio indicators remain relatively stable without significant fluctuations. Specific derivations are placed in the appendix.

When the economy reaches a steady state, equations (38-40) can represent the steady-state optimal contribution rate formula, with each variable' s subscript t replaced by "ss" :

$$\tau_{ss}^* = \frac{\lambda \sum_{k=J_R}^{J_D} N_{ss,k} f_{ss,k} \cdot \frac{W_{ss}}{P_{ss}} + \theta \frac{\Pi_{ss}^G}{P_{ss}}}{\frac{W_{ss}}{P_{ss}} L_{ss}} \cdot \frac{1}{1+\epsilon_{ss}}$$

where ϵ_{ss} is:

$$\epsilon_{ss} = \frac{\sum_{k=0}^{J_R-1} \omega_k N_{ss,k} \frac{\partial C_{ss,k}^W}{\partial \tau} + \sum_{k=J_R}^{J_D} \omega_k N_{ss,k} \frac{\partial C_{ss,k}^R}{\partial \tau}}{\sum_{k=0}^{J_R-1} \omega_k N_{ss,k} \frac{\partial C_{ss,k}^W}{\partial \tau} \cdot \frac{W_{ss}}{P_{ss}}}$$

4. Model Parameter Calibration

The optimal pension contribution rate equation involves various parameters of macroeconomic operation and demographic data, which we need to specify.

4.1 Demographic Data Calibration

For the optimal contribution rate, we examine two time nodes: 2018 and 2050. Due to the popularization of education in China, the age at which residents begin working has been significantly delayed. We calculated the weighted average working age for all young people in 2018 as 20.01 years, which we round to 20 years. The statutory retirement age is 50 for female workers, 55 for female cadres, and 60 for male residents, which we set at 58 years on average. According to WHO reports, China' s average life expectancy in 2016 was 76 years, and considering 逐年增加, we use 80 years. Residents' economic lifespan is calculated from the start of work, subtracting 20 from actual lifespan. We thus present 2018 urban population social security data and 2050 urban population data. The 2018 population data comes from the 2019 Statistical Yearbook, while 2050 data uses projections from Xiao Mingzhi (2012) [34], presented in .

** Demographic Parameter Values in the Model**

Parameter	2018 Value	2050 Value
Economic age at work start (actual age)	0 (20)	0 (20)
Economic age at retirement (actual age)	38 (58)	38 (58)
Economic age at death (actual age)	60 (80)	60 (80)
Urban insured working population (billion)	3.0104	4.627
Urban retired insured population (billion)	1.1798	3.859

4.2 Macroeconomic Data

We use macroeconomic data from the National Bureau of Statistics' 2019 Statistical Yearbook. Asset data uses the total assets of legal entities in secondary and tertiary industries from the 2018 national economic census, amounting to 914.2 trillion yuan. In 2018, SOE total assets were 210.4 trillion yuan, and state-owned financial institution assets were 17.2 trillion yuan, obtained from the State Council' s comprehensive report on state-owned asset management in 2018. From this, we estimate private enterprise total assets at 686.6 trillion yuan and SOE assets at 227.6 trillion yuan. Government bond data comes from the People' s Bank of China' s reports. Specific data are presented in .

** Macroeconomic Data Indicators and Parameters**

Parameter	Value
SOE wage share of output	0.25
Private enterprise wage share of output	0.45
Government capital share of output	0.15
Resident capital share of output	0.60
Government investment share of output	0.03
Resident investment share of output	0.12

Parameter	Value
Government expenditure share of output	0.20
Government tax share of output	0.18
Government bond share of output	0.05
SOE output share of total output	0.25
Private enterprise output share of total output	0.75
SOE depreciation rate	0.066
Private enterprise depreciation rate	0.10
SOE rental rate	0.05
Private enterprise rental rate	0.08
Government weight on each age group	1.0
Final goods production price markup	1.1

In , we set SOE output share of GDP at 0.25, which is not provided in statistical yearbooks but estimated based on 2018 national economic census data showing SOE assets accounting for 24.82% of total enterprise assets, rounded to 25%. We also specify depreciation rates: 10% annually for private enterprises (equivalent to 10-year asset life) and 6.6% for SOEs (approximately 15-year life). The lower SOE depreciation rate reflects that SOEs primarily belong to infrastructure and other industries with longer asset lifespans. SOE and private enterprise rental rates are selected following Smets and Wouters (2007) [35]. The discount rate and government weight on residents (social discount rate) are set equal due to lack of annual age-specific population data.

5. Empirical Analysis

This section conducts detailed research on specific contribution rates. We consider the case where residents' assets at the beginning and end of life are zero—meaning residents spend all earned assets during their lifetime without leaving bequests. We examine the current pension system with different percentages of SOE profits allocated to the pooling account and consider optimal contribution rates with delayed retirement.

5.1 Optimal Contribution Rate in 2018 Based on Actual Urban Employee Participation

We first consider the contribution rate in 2018 with retirement age at 58, allocating different percentages of SOE profits to the pooling account pension to calculate corresponding optimal contribution rates. In 2018, we divide into two scenarios: the first uses existing insured and retired populations as the baseline—301.04 million insured urban employees and 117.98 million retired employees. Specific results are presented in .

** Optimal Contribution Rates Based on Actual Insured Population in 2018**

SOE Profit Percentage for Pension	Optimal Contribution Rate
0%	15.27%
10%	13.67%
50%	5.32%
100%	-9.74%

Note: The first column shows different percentages of SOE profits allocated to the pooling account pension; the same applies below.

shows that when all SOE profits are allocated to the pooling account pension, the enterprise pension contribution rate is -9.74%, meaning enterprises need not contribute to pensions at all. When all SOE profits are used for government expenditures rather than pension balance, the contribution rate is 15.27%, slightly lower than the current 16% rate.

5.2 Contribution Rate with Universal Urban Employee Participation in 2018

By the end of 2018, China' s urban population was 831.37 million. Excluding the 0-19 age group leaves 647.3 million people, including 479.6 million aged 20-58 and 157.7 million aged 59 and above. Compared with actual insured numbers at the end of 2018, we find a large urban population remains outside the pension security system. We therefore assume these individuals should join the pension security system, as otherwise they would pose future social risks. We examine the optimal pooling account contribution rate when all urban residents participate in pension security. presents the results.

** Contribution Rates with Universal Urban Resident Participation in 2018**

SOE Profit Percentage for Pension	Optimal Contribution Rate
0%	12.58%
10%	11.04%
50%	3.21%
100%	-11.89%

shows that after universal participation, with more insured people than newly retired people, the contribution rate decreases by about 3 percentage points, indicating our current 16% rate has substantial room for reduction. We next consider delayed retirement scenarios in 2018.

5.3 Contribution Rate with Universal Participation and Two-Year Retirement Delay in 2018

We now consider delayed retirement, a common phenomenon worldwide and a reasonable consideration for China. Previously, retirement ages were based on working life expectancy. Before the 1990s, most Chinese workers started working younger. With increased education, the age at first employment has risen to 20. We therefore consider a two-year retirement delay, based on universal pension security participation. Specific contribution rates are presented in .

** Contribution Rates with Two-Year Retirement Delay in 2018**

SOE Profit Percentage for Pension	Optimal Contribution Rate
0%	10.09%
10%	9.17%
50%	2.45%
100%	-12.56%

shows that with a two-year retirement delay and universal pension insurance participation in 2018, the pooling account pension contribution rate can decrease by about 2 percentage points from the non-delayed scenario, providing even greater adjustment space.

5.4 Contribution Rate with Two-Year Delay and Increased Pension Distribution Coefficient in 2018

Currently, China' s pension distribution is directly related to contribution years. For example, the current distribution coefficient equals contribution years. If an urban worker starts at age 20 and retires at 61 with a two-year delay (considering average cases), the working period is 41 years, making retirement wages 0.41 times the previous year's social average wage—clearly a relatively low proportion. We can increase the pension distribution coefficient under delayed retirement, such as raising it to 1.5 times the original, making the coefficient 0.62, a significant improvement. The pooling account contribution rate under this scenario is presented in .

** Contribution Rates with Two-Year Delay and 50% Increase in Pension Distribution Coefficient in 2018**

SOE Profit Percentage for Pension	Optimal Contribution Rate
0%	14.42%
10%	12.90%
50%	4.87%
100%	-8.76%

shows that even with a 50% increase in the pension distribution coefficient under a two-year retirement delay, the pension contribution rate is only 14.42% without considering SOE profits, lower than the current 16%. If 10% of SOE profits are allocated to pensions, the contribution rate falls below 13%.

5.5 Contribution Rate with Universal Participation and No Retirement Delay in 2050

The greatest concern about our pension system is whether, as aging intensifies, we will have sufficient funds to pay pensions and whether our government will be bankrupted by pension obligations. We address this by examining the 2050 scenario. General literature assumes the economy reaches steady state and directly calculates the optimal pooling account contribution rate using equations (41-43). However, due to China' s continuously changing population and intensifying aging, the economy struggles to reach steady state. We therefore assume residents' parameter ratios remain unchanged from 2018 levels, with only demographic data differing. This assumption is somewhat forced but helps solve the problem. By 2050, aging will be severe. According to literature [34] projections, the urban population aged 20 and above will be 846.8 million, with 462.7 million aged 20-58 and 385.9 million aged 59 and above—nearly a one-to-one worker-to-retiree ratio. Contribution rates under this scenario are presented in .

** Contribution Rates with Universal Participation and No Retirement Delay in 2050**

SOE Profit Percentage for Pension	Optimal Contribution Rate
0%	28.62%
10%	25.57%
50%	15.50%
100%	2.38%

shows that without considering SOE profits, the pension pooling account contribution rate would reach 28.62%—a very heavy burden for enterprises that would greatly reduce competitiveness. Even allocating 50% of SOE profits to pensions would only reduce the contribution rate to the current 16% level.

5.6 Contribution Rate with Universal Participation and Retirement at Age 65 in 2050

Delayed retirement has become inevitable globally and will certainly apply to China, especially by 2050 when aging is severe. We therefore consider raising the retirement age to 65, which would significantly reduce pension contribution rates, as shown in .

** Contribution Rates with Retirement at Age 65 and Universal Participation in 2050**

SOE Profit Percentage for Pension	Optimal Contribution Rate
0%	15.47%

SOE Profit Percentage for Pension	Optimal Contribution Rate
10%	13.79%
50%	6.94%
100%	-1.89%

shows that if retirement age is delayed to 65, even without allocating SOE profits to pensions, the contribution rate falls below the current 16% level. Allocating more SOE profits would further reduce the rate.

5.7 Discussion of Empirical Results

The above empirical analysis reveals results somewhat different from current public perceptions. Many newspapers and magazines believe China' s pension system faces large deficits and is unsustainable. We argue this stems from an imperfect pension system.

First, considering 2018 pension revenue and expenditure data, with the current average retirement age of 58 and a pooling account contribution rate of 20% of workers' wages (adjusted to 16% in 2019). According to the Ministry of Human Resources and Social Security' s 2018 report, urban employee basic pension insurance fund revenue was 5,116.8 billion yuan, with total expenditures of 4,464.5 billion yuan—clearly revenue exceeded expenditures. However, the 2018 report did not disclose contribution income. We can reference 2017 data.

With the current average retirement age of 58 and a pooling account contribution rate of 20% of workers' wages before 2018, the Ministry' s 2017 report shows urban employee basic pension insurance fund contribution income of 3,340.3 billion yuan, with total expenditures of 3,805.2 billion yuan. Without fiscal subsidies, our pension system would face a negative gap, with insufficient revenue. Examining participation numbers, beneficiaries, and urban employees reveals the problem. At the end of 2017, China had 424.62 million urban employees, 292.68 million insured employees, and 110.26 million insured retirees, yielding an actual participation rate of only 68.93%. Second, the 2017 average wage for urban employees was 74,318 yuan, and for urban private units 45,761 yuan. Assuming all urban employees, private enterprise employees, and self-employed individuals participated, total insured employee wages would be 23,365.2 billion yuan. At a 20% contribution rate, pension revenue would be 4,673 billion yuan, fully covering expenditures. However, due to contribution exemptions for some enterprises, the actual collection rate is 14.29%. This shows that although China' s nominal pension contribution rate is 20% (reduced to 16% for enterprises since 2019), our pension system still has room for improvement.

6. Conclusions and Policy Recommendations

This paper establishes a model for the optimal contribution rate of the pension pooling account, examining different proportions of SOE profits allocated to the pooling account pension to derive corresponding optimal contribution rates under various conditions. We reach the following conclusions:

1) Maintaining the current retirement age (58) and participation rate, we find the pension contribution rate is 15.27% without using SOE profits for the pooling account, and 13.67% when 10% of SOE profits are allocated to the pooling account.

2) Maintaining the current retirement age (58) but implementing universal participation, we find the contribution rate is 12.58% without SOE profits, and 11.04% with 10% of SOE profits allocated.

3) Delaying retirement by two years (average age 60) with universal participation yields a contribution rate of 10.09% without SOE profits, and 9.17% with 10% of SOE profits allocated.

4) Delaying retirement by two years (average age 60) with universal participation and increasing the pension distribution coefficient by 50% yields a contribution rate of 14.41% without SOE profits, and 12.90% with 10% of SOE profits allocated.

5) By 2050, maintaining the current retirement age (58) with universal participation would require a contribution rate of 28.26% without SOE profits, 25.57% with 10% of SOE profits allocated, and 15.50% even with 50% of SOE profits allocated—slightly below the current rate.

6) By 2050, delaying retirement to age 65 with universal participation yields a contribution rate of 15.47% without SOE profits, and 13.79% with 10% of SOE profits allocated.

Our analysis reveals a major problem in China' s current pension system: many urban employees have not joined the urban employee pension insurance, resulting in low participation rates that reduce pooling account revenue. These uninsured residents will lack stable income in old age, posing risks to social stability. We therefore recommend the government formulate policies to ensure all urban employees participate in pension insurance, achieving universal coverage. Additionally, with improved education levels delaying work start ages and improved health conditions increasing life expectancy, China' s retirement age is too early, generally lower than developed countries. Based on these conclusions, we propose the following policy recommendations:

1) China should enact laws mandating all residents to participate in social insurance, especially pension insurance.
2) Gradually increase the national retirement age.
3) After establishing a sound social insurance system, encourage residents to consume their assets rather than leaving them to descendants, potentially through inheritance taxes.
4) Since China has already transferred 10% of state-owned assets to the social security fund, we believe that with an improved social insurance system, the pension pooling account contribution rate can be appropriately

reduced, for example to 12%, to enhance Chinese enterprises' competitiveness.

7. Limitations and Future Work

This paper uses an OLG-like model to study China' s optimal pension pooling account contribution rate, drawing conclusions and offering reform recommendations. However, limitations exist: we do not consider residents leaving bequests to descendants, and future Chinese population data are adopted from others' research rather than being modeled in-depth. For future work, we have constructed a model describing China' s macroeconomic system and applied it to pension pooling account contribution rate research. However, due to different research focuses, we have not fully developed this model. We hope future work will focus on studying a socialist macroeconomic model with Chinese characteristics to reveal the mysteries of China' s economic development.

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Gaoxun Zhang, Bei Zhang: Collected, cleaned, and analyzed data
Kaiming Wang, Gaoxun Zhang, Bei Zhang: Drafted the manuscript
Kaiming Wang: Revised final version of the paper

Note: Figure translations are in progress. See original paper for figures.