Delayed Retirement and Contribution Reform in China: A General Equilibrium Analysis

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Abstract

How does delayed retirement policy affects agent behavior and the aggregate economy in China? To evaluate this policy, we develop a heterogeneous OLG model with endogenous retirement choice and the contribution/benefit rules of the social security system in China. We find that delayed retirement policy increases the welfare and reducing the pension deficit. The policy's effects are heterogeneous across different groups: agents with a low contribution base and high productivity tend to delay retirement, while others are less likely to do so. Furthermore we examine a comprehensive policy reform. Delayed retirement with a increase in the lower contribution bound emerges as a superior policy mix, as it significantly boosts consumption by 2.34% and welfare by 1.06%, while simultaneously improving pension finances and income equity. In contrast, adjusting the upper bound has a negligible impact.

Keywords: Social Security, Delayed Retirement, Heterogeneous Agents

1. INTRODUCTION

Globally, rapid population aging poses an unprecedented challenge to the sustainability of public pension systems. In China, this challenge is particularly acute, driven by the country's exceptional pace of demographic transition and its distinctive institutional arrangements. As the central pillar of China's social security framework, the Urban Employee Basic Pension Insurance system—fundamentally a pay-as-you-go (PAYG) scheme—faces escalating fiscal pressure and deep-seated institutional deficiencies.

Three structural problems are especially prominent. First, the contribution structure is regressive: due to the upper and lower bounds on the contribution base, high-income groups enjoy substantially lower effective contribution rates than the statutory nominal rate, whereas the burden on low- and middle-income groups is comparatively heavy. This severely undermines the intended redistributive function of the pension system (Li and Wang, 2010; Ji et al., 2022). Second, pension replacement rates remain persistently low, failing to adequately secure retirees' quality of life. Third, the system's long-term sustainability is under threat. The rapid expansion of the retired population, coupled with a shrinking working-age cohort, has led to widening pension fund deficits, while the long-standing issue of unfunded individual accounts imposes immense pressure on public finances (Peng et al., 2008).

The Chinese government initiated the flexible delayed retirement in 2025. However, the net effects of these reforms are far from straightforward, involving complex economic trade-offs. This paper aims to quantitatively evaluate the aggregate and distributional impacts of this key reform and as well as other potential policy changes.

Our research is motivated by a central economic question: in the presence of significant agent heterogeneity, how should pension policy be designed to simultaneously achieve financial sustainability, macroeconomic efficiency, and distributional equity? Compared to the traditional one-size-fits-all approach of delaying retirement, a flexible retirement system allows individuals to make more optimal retirement decisions. However, decisions and inventives are heterogeneous: for example, a low-income agent facing adverse productivity shocks may retire early due to liquidity constraints, while a healthy, high-productivity, high-income agent may choose to delay retirement. Understanding how these individual choices aggregate to affect macroeconomic outcomes, and how they interact with institutional features such as contribution base rules, is critical for policy evaluation and remains insufficiently addressed in the current literature.

To address these issues, we develop an OLG model with two key innovations tailored to China's institutional context. First, the model precisely captures the non-linear contribution base rules in the China pension system, incorporating the upper and lower bounds on contributory wages and distinguishing the complex benefit formulas for both the social pooling and individual accounts. Also, the pension benefit is a function of the individual contribution history, which alings with the practice in reality. This enables us to rigorously assess the regressivity of the system and the true distributional effects of reform, in contrast with much of the international literature based on developed economies (e.g., Fehr et al., 2009), and to deepen the some literature (e.g., Wang, 2014; Ning, 2024), which often lacks sufficient institutional detail.

Second, we embed an endogenous retirement choice into the OLG framework. Agents are no longer constrained to a fixed statutory retirement age; instead, they dynamically and optimally choose to retire at age 60, 63, or 66. This allows us to analyze behavioral heterogeneity among different income and contribution groups and to evaluate the net impact of flexible retirement policies on the labor market, income distribution, and social welfare. The model in this paper complements This approach addresses prior studies, which either focus on micro-level decision-making (e.g., Blundell et al., 2016) or treat the retirement age as exogenous in macroeconomic models (e.g., Feng, 2019). While some research has acknowledged the potential of flexible retirement (e.g., Wang and Wang, 2021), it has so far lacked a general equilibrium framework to assess macro-level feedback effects.

Finally, this study contributes to the quantitative literature on China's economic transition and income distribution. Recent work has used structural models to analyze Chinese savings, capital misallocation, and inequality (e.g., Song et al., 2015; He et al., 2019). In the pension field, some scholars have begun to investigate distributional effects (e.g., Li et al., 2019; Ning, 2024). Our unique contribution is to systematically analyze the interaction between flexible retirement and contribution base reforms—two core tools of China's pension policy. By quantifying their joint and potentially conflicting effects, we reveal complex economic consequences that single-policy analyses might overlook, thereby providing nuanced and robust quantitative evidence for policymakers seeking to balance efficiency and equity.

By developing and calibrating this model, our research yields a series of core findings. In the benchmark with a fixed retirement age, we find that adjustments to the upper and lower bounds of the contribution base have significantly asymmetric effects. While changing the upper bound has a negligible impact on macroeconomic aggregates, adjusting the lower bound produces profound consequences. Surprisingly, a increase in the lower bound (e.g., from 60% to 80% of the social average wage), despite imposing a higher immediate burden on low-income groups, generates substantial macroeconomic benefits by enhancing the pension replacement rate and improving the system's finances, ultimately boosting aggregate consumption and overall social welfare by 2.34% and 1.06%, respectively. When we introduce the flexible delayed retirement policy, it delivers macroeconomic benefits on its own, leading to modest gains in output (0.05%) and welfare (0.06%) while markedly reducing the pension deficit. This improvement is driven by the optimal choices of heterogeneous agents: workers with high productivity but a relatively low contribution base are most motivated to delay retirement for higher pensions, whereas those facing negative shocks or who have already accumulated a high contribution base prefer to retire earlier. This finding resonates with the literature on how longevity and health heterogeneity affect retirement decisions (Jones and Li, 2020; Yu, 2021)

To test the robustness of our conclusions and explore the impact of different institutional designs, we conduct a series of counterfactual experiments. The most critical of these assumes that agents begin contributing from the start of their careers (age 21) rather than only in the years leading up to retirement. This setup fundamentally reverses some of our core findings. The previously beneficial policy of "raising the lower contribution bound" now leads to a welfare loss. The underlying mechanism is that forcing younger, less productive workers to adhere to a high contribution floor imposes a significant distortion on their life-cycle saving and consumption decisions, a loss that the redistributive effect on the benefit side can no longer fully offset. Furthermore, with the retirement decision decoupled from the ability to extend one's contribution period, the positive impact of the flexible retirement policy is also substantially weakened. This result reveals a critical insight: the welfare effects of pension reforms are not absolute but are highly contingent on their interaction with the life-cycle productivity profile and other institutional rules, particularly the timing and duration of contributions.

1.1. Literature Review

This study builds upon three main branches of the literature: quantitative macroeconomic analysis of pension reforms, research on endogenous retirement decisions and labor supply, and quantitative studies on the distributional effects of pension systems.

The first strand of literature utilizes Overlapping Generations (OLG) models to evaluate the macroeconomic and welfare impacts of pension reforms, a practice established since the seminal work of Auerbach and Kotlikoff (1987). This framework has been used to explore a wide range of policy issues. For instance, Krueger and Kubler (2006) analyze social security in the context of incomplete financial markets, finding that adjusting replacement rates can optimize intergenerational welfare, while Conesa and Garriga (2008) highlight that reforms are often hindered by a "status quo bias." Recent research has extended this framework to explore the system's progressivity and the effects of policy uncertainty. Nishiyama and Smetters (2007) find that partially privatized pension systems can enhance labor supply incentives but may weaken risk-sharing for low-income groups. Policy uncertainty has been shown to have significant welfare and macroeconomic costs; Luttmer and Samwick (2015) demonstrate that agents are willing to sacrifice a substantial portion of their expected benefits to eliminate such uncertainty, and Kitao (2018)'s research on Japan finds that delaying reforms exacerbates this uncertainty, leading to reduced labor supply and capital accumulation. While this body of work is extensive, many models simplify key institutional features, such as the non-linear contribution and benefit rules prevalent in systems like China's. Although studies such as Wang (2014) and Yan (2016) have focused on the Chinese context, they often make similar simplifications, which limits a precise assessment of the distributional consequences of specific policy changes.

A second critical area of research focuses on endogenous retirement decisions and their impact on labor supply, which has advanced along two main fronts. One stream consists of micro-econometric studies using individual-level data to identify the determinants of retirement, such as health, wealth, and policy incentives, as explored by French (2011) and Blundell et al. (2016). Pashchenko and Porapakkarm (2016) further investigate pension claiming behavior, finding that subjective valuations of annuities and bequest motives are key drivers, and that lump-sum incentives for delaying retirement could significantly alter these decisions. The other stream embeds these choices into macroeconomic models to analyze general equilibrium effects. For example, Imrohoroglu and Kitao (2011) suggest that reducing benefit levels is more effective than raising the retirement age in incentivizing later retirement, while Yu (2021) attributes the recent rise in labor force participation among older U.S. men to reforms that increased the rewards for delayed retirement. Additionally, studies by Huggett et al. (2010) and Kitao (2014) show how tax policies and the structure of benefit adjustments can influence labor supply and capital accumulation across the life cycle. Despite these advances, research that integrates rich agent heterogeneity, complex institutional details, and endogenous retirement choices within a single macroeconomic framework remains relatively scarce.

The third strand of literature examines the distributional consequences of pension systems. It is well-established that pension systems play a crucial role in income redistribution and can mitigate wealth concentration arising from intergenerational transfers, as shown by De Nardi (2004). However, this redistributive function is often complicated by longevity heterogeneity. Studies by Goda et al. (2011) and Jones and Li (2020) both find that because higher-income agents tend to have longer life expectancies, they receive a disproportionately larger share of lifetime pension benefits, which can render an otherwise progressive system regressive in effect. This highlights the importance of accounting for demographic differences when evaluating policy outcomes. Within this broader context, scholars have begun to apply quantitative models to explore the distributional effects of China's specific pension framework, as seen in the work of Li et al. (2019) and Ning (2024). These studies provide valuable insights into the redistributive capacity of the current system. However, the existing literature has not yet systematically analyzed the interaction between two of the most central policy tools in China's pension reform: flexible retirement policies and adjustments to the contribution base. Assessing the potential synergistic or conflicting effects when these two policies are implemented jointly remains a significant gap in the current research.

2. MODEL

This section develops a dynamic general equilibrium Overlapping Generations (OLG) model featuring heterogeneous agents, endogenous retirement choice, and incomplete markets. Agents in the model economy face idiosyncratic labor income shocks over their life cycle and make optimal decisions regarding consumption, savings, and the timing of retirement. The core feature of the model is its endogenous linkage of the contribution and benefit rules of China's urban basic pension system with agents' flexible retirement choices.

2.1. Households

2.1.1. Life Cycle

The model economy is populated by a continuum of heterogeneous agents with finite lifespans. An agent enters the labor market at age 21 (period $j = 1$ in the model) with zero initial assets and can live up to a maximum age of 80 (period J). Each period represents one year. Agents face uncertain mortality risk; the conditional probability of surviving from age j to $j+1$ is given by ψ_j. Deviating from traditional models with a fixed retirement age, this model incorporates a flexible retirement mechanism. After reaching the statutory retirement age, an agent can choose their retirement timing from a pre-specified set of ages, $J_R = \{J_{R_1}, ..., J_{R_n}\}$. Once retired, the agent exits the labor force, ceases to earn labor income, and begins to receive pension benefits. An agent must retire upon reaching the maximum age in the set, J_{R_n}.

2.1.2. Preferences

Agents derive utility from consumption. Their lifetime expected utility is represented by a time-separable utility function, which takes the following form in period t:

$$E_t \left\{ \sum_{j=1}^{J} \beta_j \left(\prod_{i=1}^{j-1} \varphi_i \right) U\left(c_j\right) \right\} \tag{1}$$

where E_t is the expectations operator, β_j is the age-specific discount factor, and $\Pi\psi_i$ is the unconditional probability of surviving to age j. The instantaneous utility function $U(c)$ is of the standard CRRA form:

$$U(c) = \frac{c^{1-\sigma}}{1-\sigma}, \quad \sigma > 0 \tag{2}$$

where c denotes consumption and σ is the coefficient of relative risk aversion, the inverse of which is also the elasticity of intertemporal substitution.

2.2. Retirement Decisions

2.2.1. Households' Decision Path

At each potential retirement age $j = J_{R_i} \in J_R$, an agent faces a critical choice: to continue working or to retire. The decision is made to maximize lifetime expected utility. This problem is characterized by the following Bellman equation:

$$V_t\left(a_t, \eta_t, \bar{B}_{t-1}, j, J_{R_i}\right) = \max_{c_t, a_{t+1}} \left\{V_t^{work}, V_t^{retire}\right\} \tag{3}$$

where V_t^{work} and V_t^{retire} are the value functions for choosing to work and retire, respectively. The state variables include assets at the beginning of the period a_t, the stochastic productivity shock ϵ_t, the average contribution base from the previous period $\bar{B}_{t-1}$, current age j, and the current target retirement age J_{R_i}.

If Continuing to Work is Chosen ($V_t^{work} > V_t^{retire}$): The agent gives up the opportunity to retire at the current age $j = J_{R_i}$ and defers the retirement decision to the next available node, $J_{R_{i+1}}$. Consequently, the target retirement age in their state vector is updated from J_{R_i} to $J_{R_{i+1}}$. The agent continues to work and contribute to the pension system until they reach this new decision node at age $J_{R_{i+1}}$, at which point they face the same comparison again. This sequential process continues until the agent either chooses to retire or reaches the final mandatory retirement age, J_{R_n}.

If Retirement is Chosen ($V_t^{work} < V_t^{retire}$): The retirement decision becomes final and irreversible. The age $j = J_{R_i}$ becomes the agent's final and actual retirement age. For all subsequent periods of their life, the retirement age in their state vector is locked in at J_{R_i}. The agent permanently enters the retired state, ceases to work, and begins to receive pension benefits according to the established rules.

In summary, at any given period t, an agent's lifecycle status (working, deciding, or retired) is determined by their current age j and their target retirement age J_{R_i}. When $j < J_{R_i}$, the agent is in a working state. When $j = j < J_{R_i}$, the agent is at a critical decision node. Once the retirement choice is made, for all subsequent ages $j > j < J_{R_i}$, the agent will be in the retired state.

2.2.2. Continue Working

If the agent chooses to continue working, the value function is:

$$V_t^{work}\left(a_t, \eta_t, B_{t-1}^{-}, j, J_{R_i}\right) = \max_{c_t, a_{t+1}} \left\{U\left(c_t\right) + \beta E_t\left[\varphi_t V_{t+1}\left(a_{t+1}, \eta_{t+1}, \bar{B}_t, j+1, J_{R_{i+1}}\right)\right]\right\} \tag{4}$$

This decision is subject to the budget constraint:

$$\begin{aligned}(1+\tau_c)c_t + a_{t+1} &= (1+\tilde{r}t)a_t + (1-\tau ss, t)w_t\epsilon_t\eta_j(1-Q(t)) \\ &+ w_t\epsilon_j\eta_t Q(t) - T_y((1-\tau_{ss,t})w_t\epsilon_j\eta_t)(1-Q(t)) \\ &- T_y(w_t\epsilon_j\eta_t)Q(t) + beq_t + Tr\end{aligned} \tag{5}$$

where $\tilde{r}_t = r_t\left(1-\tau_b\right)$ is the after-tax interest rate and τ_c is the consumption tax rate. The pre-tax labor income, $w_t\epsilon_j\eta_t$, is determined by the aggregate wage rate w_t, an age-dependent deterministic productivity profile η_j, and a stochastic productivity shock ϵ_t that follows an AR(1) process. $\tau_{ss,t}$ is the contribution rate. $T_y(\cdot)$ is a progressive income tax function. beq_t and Tr represent bequests received and government transfers, respectively.

$Q(t)$ is a contribution period indicator function. The design of this function aims to capture two key incentive mechanisms within China's pension system. First, since interruptions in contributions often lead to significant penalties (e.g., affecting pension benefit calculations), agents have a strong incentive for continuous contributions. Second, eligibility for pension benefits is strictly tied to meeting a minimum contribution period (e.g., 15 years), which creates a powerful incentive for agents to ensure their contribution records are complete as they approach retirement.

Based on these incentives, the model employs a realistic simplification: we assume a common starting age for contributions for all agents. This starting age is precisely set to the point where an agent can fulfill the minimum required contribution years, $J_{contrib}$, just by the time they reach the earliest possible retirement age, J_{R_1}. Therefore, the starting age of contribution is fixed for everyone. However, the end of the contribution period is endogenously determined by the agent's chosen retirement age, J_{R_i}. Therefore, $Q(t)$ is defined as follows:

$$Q(t) = \begin{cases} 0 & \text{if } j \leq J_{R_1} - J_{contrib} \text{ } or \text{ } j > J_{R_i} \\ 1 & \text{if } J_{R_1} - J_{contrib} < j \leq J_{R_i} \end{cases} \tag{6}$$

which, for an agent who chooses to retire at age J_{R_i}, $Q(t)$ equals 1 if their current age j is within the interval $(J_{R_1} - J_{contrib}, J_{R_i}]$, and 0 otherwise. This mechanism elegantly endogenizes the trade-off between delaying retirement and increasing pension contributions, allowing the model to more realistically capture the decision-making process agents face under a flexible retirement policy.

2.2.3. Choose to Retire

If the agent chooses to retire, the value function is:

$$V_t^{retire}\left(a_t, B_{t-1}^{-}, \eta_t, j, J_{R_i}\right) = \max_{c_t, a_{t+1}} \left\{U\left(c_t\right) + \beta E_t\left[\varphi_t V_t^{retire}\left(a_{t+1}, \bar{B}_t, \eta_{t+1}, j+1, J_{R_i}\right)\right]\right\} \tag{7}$$

Upon retirement, the agent has no labor income, and the budget constraint simplifies to:

$$(1+\tau_c)c_t + a_{t+1} = (1+\tilde{r}_t)a_t + pen_t + beq_t + Tr \tag{8}$$

where pen_t is the pension benefit received in the current period.

2.3. Pension System

2.3.1. Contribution Rules

An agent's pension contribution, Tss, is the product of their contribution base, B_t, and the nominal contribution rate, τ_{ss}:

$$Tss = \tau_{ss} B_t \tag{9}$$

The determination of the contribution base, B_t, is a central feature of China's pension system. It is not directly equal to agent labor income but is capped by upper and lower limits relative to the average social wage, $\bar{w}$. Specifically:

$$B_t = \begin{cases} \underline{\kappa}\bar{w} & \text{if} \quad (w_t\epsilon_t\eta_j) \leq \underline{\kappa}\bar{w} \\ (w_t\epsilon_t\eta_j) & \text{if} \quad \underline{\kappa}\bar{w} < (w_t\epsilon_t\eta_j) < \bar{\kappa}\bar{w} \\ \bar{\kappa}\bar{w} & \text{if} \quad \bar{\kappa}\bar{w} \leq (w_t\epsilon_t\eta_j) \end{cases} \tag{10}$$

where $\underline{\kappa}$ and $\bar{\kappa}$ are the lower and upper bound coefficients for the contribution base (e.g., 0.6 and 3.0, respectively). The average social wage $\bar{w}$ is endogenously determined by agents who are still working:

$$\bar{w} = \int_{(a,\eta,\bar{B},j,j\leq J_{R_i})} \Phi(\cdot) \times (w\epsilon_j\eta) d\Phi \tag{11}$$

Where Φ is the stationary distribution. The agent's pension contribution ratio (compared to labor income) is:

$$\tau_{ss,t} = \frac{\tau_{ss}B_t}{w_t\epsilon_t\eta_j} \tag{12}$$

The average contribution base of an agent is determined by the contribution path in history. Assuming that an agent's (age j) current average contribution base is $\bar{B}_{t-1}$ and its current contribution base is B_t, then its next average contribution base is:

$$\bar{B}_t = \frac{\bar{B}_{t-1} \times (j-1)}{j} \tag{13}$$

The agent's lifetime average contribution base is defined as the average of all their contribution bases over the last $J_{contrib}$ years:

$$\bar{B}_{J_{contrib}} = \frac{1}{J_{contrib}} \sum_{t=1}^{J_{contrib}} B_t \tag{14}$$

2.3.2. Benefit Rules

Upon retirement, an agent's pension benefit, pen_t, consists of two components: a pooled account benefit and an individual account benefit:

$$pen_t = pen_{pool} + pen_{indi} \tag{15}$$

The pooled account pension, pen_{pool}, reflects the social redistribution function and is calculated as:

$$pen_{pool} = \bar{w} * \left(1 + \frac{\bar{B}_{J_{contrib}}}{\bar{w}}\right) * J_{contrib} * 1\% * \frac{1}{2} \tag{16}$$

This component is linked to the social average wage $\bar{w}$, the agent's average contribution base $\bar{B}_{J_{contrib}}$ over their entire contribution history, and the number of contribution years $J_{contrib}$. The individual account pension, pen_{indi}, follows an actuarially fair principle. It is calculated by dividing the accumulated balance in the individual account by a payment month, Z:

$$pen_{indi} = \left(\sum_{t=J_{R_i}-J_{contrib}}^{J_{R_i}} (B_t * 8\% * (1 + r_{pen}))^{J_{R_i}-t} \right) * \frac{1}{Z} \tag{17}$$

where the factor Z depends on the retirement age J_{R_i}.[1]

The social security replacement rate represents the proportion of the pension received by agents after retirement compared to their pre-retirement salary:

$$\bar{\lambda} = \int_{(a,\eta,\bar{B},j,j=J_{R_i})} \Phi(\cdot) \times (\frac{pen}{w\epsilon\eta_{J_{R_i}}})d\Phi \tag{18}$$

2.4. Firm

There is a representative firm in the economy that uses capital $K_t = \int a_t d\Phi$ and labor $L_t = \int \eta_j \epsilon_t d\Phi$ for production. The production technology is described by a constant-returns-to-scale Cobb-Douglas function:

$$Y_t = K_t^{\alpha}(AL_t)^{1-\alpha} \tag{19}$$

where A is the level of labor-augmenting technology. In a competitive market, the firm's profit maximization yields the equilibrium interest rate r_t and wage rate w_t:

$$r_t = \alpha K_t^{\alpha-1}(A_t L_t)^{1-\alpha} - \delta_k \tag{20}$$
$$w_t = (1-\alpha)K_t^{\alpha}(A_t)^{1-\alpha}(L_t)^{-\alpha} \tag{21}$$

where δ_k is the capital depreciation rate.

2.5. Government

The government finances public expenditures and transfers for the pension system by levying consumption, capital, and income taxes. The pension system operates on a pay-as-you-go basis, where current contributions are used to pay for the benefits of current retirees.

$$T_r + pen_t = T_y\left(\left(1-\tau_{ss,t}\right) w_t \epsilon_j \eta_t\right) \times \Phi(\cdot) + \sum_{t=J_{R_i}-J_{contrib}}^{J_{R_i}} B_t \times \tau_{ss} \times \Phi(\cdot) + beq_t \tag{22}$$

$$beq_t = \sum_{j=1}^{J-1} (1-\psi_j) \times a_j \times \Phi(\cdot) \tag{23}$$

[1] According to the agent's retirement age and life expectancy, it is planned to pay all the individual account deposits in the corresponding number of months. For example, for retirement at age 60, Z = 139 months; for retirement at age 63, Z = 117 months.

2.6. General Equilibrium

$s = (a, \eta, \bar{B}, j, J_R)$ represents the state variable of agents, and $\Phi(s)$ represents the distribution function in the economy. Given the pension replacement rate λ , the government's balance of payments structure $(\tau_b, \tau_c, T_y(\cdot), G_i)$, general equilibrium is balanced by the value function $\left\{V(s), V^{work}(s), V^{retire}(s)\right\}$, policy functions $\{c(s), a'(s)\}$, firm production plan $\left\{Y^C, K^C, N^C\right\}$, A set of price $\{r, w\}$ and distribution $\Phi(s)$, and satisfy the following conditions:

- Household decision rules $\{c(s), a'(s), J_R(s)\}$ maximize lifetime utility.
- Firm profit maximization.
- Capital/Labor market clearing.
- Government budget balance.
- Invariant distribution satisfies:

$$\Phi(s') = \int_{\{s:a'(s)\in A, \bar{B}'(s)\in B, J_R'(s)\in JR\}} \varphi_j \Pr(\eta'|\eta) d\Phi(s) \tag{24}$$

3. CALIBRATION AND ESTIMATION

3.1. Model

The analytical framework of this study consists of a Benchmark Model and a series of Policy Experiments, which differ primarily in their retirement system specifications:

3.1.1. Benchmark Model

In this setting, we do not incorporate a flexible retirement mechanism. The retirement age for all agents is exogenously fixed at 60 (period 40 in the model). This can be represented by a singleton set for potential retirement ages: $J_R = \{40\}$. This model is designed to simulate the institutional environment prior to the reforms.

Policy Experiments. : In the policy experiments, we introduce a flexible retirement mechanism. Agents are allowed to make an endogenous and dynamic choice of their retirement age among 60, 63, and 66. The set of potential retirement ages is thus defined as $J_R = \{40, 43, 46\}$. In addition, we will do some other policy adjustments such as changes in the upper and lower limits of contributions.

3.2. Exogenous parameters

To conduct a quantitative analysis, we calibrate the model's key parameters (see Table 1).

3.2.1. Demographics

Each period in the model represents one year. Agents enter the economy at age 21 and live for a maximum of J periods, corresponding to a real age of 80. According to the natural population growth rate from 2010 to 2021 published by the National Bureau of Statistics, the average population growth rate g_n= 0.004is calculated, and the survival rate of agents $\{\psi_j\}_{j=1}^J$ is from the data of the sixth national census in 2010.

3.2.2. Preferences

According to Heathcote et al. (2017), this paper takes the coefficient of $\sigma = 1.5$. Since agents in different age groups attach different importance to the future, this paper sets the discount factor ,$\bar{\beta}$, as 0.985, and calibrates the decreasing rate of the discount factor $slope_\beta = 0.999$ to match the capital-output ratio in the data so that $K/Y = 3$. Here, it is assumed that the discount factor decreases at a fixed rate $slope_\beta$, which also reflects that the young are more willing to save for the future, and the old are more willing to consume to obtain satisfaction.

3.2.3. Income process

The agent labor income process consists of a deterministic and a stochastic component. We estimate the age-dependent deterministic life-cycle productivity profile, $\{\eta_j\}$, using panel data from the CHNS. The stochastic component, $\{\epsilon_t\}$, is modeled as an AR(1) process. Its persistence coefficient, ρ, and the variance of the shocks, σ_ϵ^2, are also estimated from the income residuals of the CHNS data using the method of moments, with:

$$\ln (y_{it}) = \beta_0 + \beta_1 \text{ age } + \beta_2 \text{ age }^2 + \gamma^T X_{it} + u_{it}$$

Where

$$u_{it} = \eta_{it} + v_{it}$$
$$\eta_{it} = \rho \eta_{it-1} + \epsilon_{it}$$

Among them, the persistence coefficient ρ of random productivity shocks is 0.692, and the variance σ_ϵ is 0.284. To solve the model numerically, we discretize the above AR(1) process into a seven-state Markov process using the method of Tauchen (1986).

Production and Taxation. The capital share in the production function, α, is set to 0.5, and the capital depreciation rate, δ_k, is 0.1 (Bai et al., 2006). The labor-augmenting technology level, A, is normalized to 1. Parameters for the government's tax system, including consumption tax, capital tax, are calibrated to match China's statutory rates and effective tax burdens, drawing on studies such as Kaiming Guo (2021). This paper assumes that a progressive personal income tax (Li and Wang, 2023):

$$T_y(y) = \tau_0 \left(y - \left(y^{-\tau_1} + \tau_2 \right)^{-1/\tau_1} \right) \tag{25}$$

where τ_0, τ_1, and $\tau_2$are respectively the tax burden intensity coefficient of labor income tax that measures the average tax burden level, the progressive coefficient of labor income that reflects the characteristics of marginal tax rate, and the constant term of labor income.

3.2.4. Pension System

Based on the current regulations of China's urban basic pension system, we set the upper and lower bound coefficients for the contribution base, $\bar{\kappa}$ and $\underline{\kappa}$, to 3.0 and 0.6, respectively. The total nominal contribution rate, τ_{ss}, is set to 28% (of which 8 percentage points are channeled into the individual account). The interest rate credited to individual accounts, r_{pen}, is set to 2.62%, reflecting the average from 2000 to 2015.

Table 1: Calibration of Exogenous Parameters

Parameter	Value	Description	Data Source
Demographics			
g_n	0.004	Population growth rate	Avg. 2010-2021
$\{\psi_j\}_{j=1}^J$	Survival Prob.	Sixth National Census	
J	60	Maximum age	Avg. life expectancy
J_R	40	Retirement age	Avg. retirement age
Preferences			
σ	1.5	Coeff. of relative risk aversion	Heathcote et al. (2010)
β	0.985	Discount factor	Standard literature value
Income Process			
ρ	0.692	Persistence of prod. shock	CHNS
σ_ϵ	0.284	Std. dev. of prod. shock	CHNS
ϵ_j	Det. Prod.	Deterministic productivity	CHNS
Production			
α	0.5	Private capital's income share	Bai et al. (2006)
δ_k	0.1	Capital depreciation rate	Bai et al. (2006)
A_t	1.0	Labor-augmenting technology	TFP
Pension Account			
$\bar{\kappa}$	3	Upper bound for contribution	Pension System
$\underline{\kappa}$	0.6	Lower bound for contribution	Pension System
τ_{ss}	0.28	Contribution rate	Pension System
Government			
τ_c	0.096	Consumption tax	Gov. GDP ratio
τ_b	0.280	Capital tax	Gong (2009)
τ_0	0.316	Tax progressivity parameter	Income Taxation
τ_1	2.263	Tax progressivity parameter	Income Taxation
τ_2	0.105	Tax progressivity parameter	Income Taxation
r_{pen}	0.0262	Interest rate on indiv. account	Avg. rate

3.3. Endogenous parameter

Two other crucial parameters—the age-related slope of the discount factor ($slope_\beta$) and the average contribution period ($J_{contrib}$)—are determined via endogenous model calibration (see Table 2). We jointly choose these parameters so that the model's steady-state equilibrium simultaneously matches two key macroeconomic targets: a capital-output ratio of approximately 3.0 and an average replacement rate of the basic pension system of around 45.8%. This procedure ensures that the model is consistent with the Chinese economy in the core dimensions of capital accumulation and old-age security provision.

4. MODEL FIT AND VALIDATION

4.1. Aggregate Moments

As shown in Table 3, the model demonstrates an excellent fit with the data. Regarding the targeted moments, the model generates a capital-to-output ratio of 3.01 and an average

Table 2: Calibrated Parameters and Targets

Parameter	Value	Description	Target
$slope_\beta$	0.999	Discount factor slope	Capital-output ratio = 3
$J_{contrib}$	18	Average contribution period	Replacement rate = 0.458

pension replacement rate of 46.1%, which are in close agreement with our calibration targets of 3.00 and 45.8%, respectively.

Beyond the targeted moments, the model also demonstrates strong performance in replicating several non-targeted features of the Chinese economy. The model-generated Gini coefficient for income is 0.445, closely matching the 0.465 figure reported for China's disposable income in 2024. Furthermore, the model's retiree-to-worker ratio of 0.261 is identical to the official ratio reported in the 2022 Statistical Bulletin on Human Resources and Social Security Development. The average effective social security contribution rate in the model is 0.297, slightly higher than the statutory rate of 0.280. This discrepancy is consistent with the institutional reality in China, where contribution base floors and ceilings cause the effective rate to be regressive: high-income earners face a lower effective rate, while low-income earners face a higher one, pushing the average effective rate above the nominal rate. Finally, the model's average consumption-to-income ratio of 0.722 aligns remarkably well with the 0.724 figure calculated from the China Household Finance Survey (CHFS) data (2013-2017). This robust validation suggests that our model not only captures the key targeted macroeconomic ratios but also accurately reflects China's income inequality, demographic structure of the pension system, and core features of household consumption behavior.

Table 3: Model Fit: Benchmark Model vs. Data

Variable	Benchmark Model	China Data
Targeted Moments		
Capital-output ratio	3.01	3.00
Average pension replacement rate	0.461	0.458
Non-targeted Moments		
Gini coefficient of income	0.445	0.465
Retiree-to-worker ratio (urban)	0.261	0.261
Average effective social contribution rate	0.297	0.280
Average consumption-to-income ratio	0.722	0.724

5. QUANTITATIVE ANALYSIS

This section systematically presents the core findings from our quantitative model to evaluate reform paths for China's urban employee basic pension system. The analysis proceeds in three stages. First, we establish and calibrate a benchmark model without flexible retirement to replicate the core features of the current system and analyze the stand-alone effects of contribution base adjustments. Second, we introduce an endogenous flexible retirement mechanism to assess the independent impact of this key reform. Finally, and central to this paper, we delve into the complex interactions between flexible retirement policies and adjustments to the pension contribution base (both the upper and lower bound), uncovering the macroeconomic, distributional, and welfare consequences of different policy combinations.

5.1. Evaluating Core Pension Reforms

We construct a benchmark model in which all agents are mandated to retire at age 60. This model serves as the reference point for subsequent policy experiments. To quantify welfare effects, we follow the methodology of Sommer and Sullivan (2018) and Kaas and Kimasa (2021), using the consumption equivalent variation (CEV) as our welfare metric. Specifically, we calculate the percentage increase in consumption under the original policy that would be required to make an agent indifferent to the new policy. Our steady-state analysis focuses on the welfare change for a newborn cohort, which we take as the measure of the policy reform's welfare impact.

5.1.1. Aggregate

Within the benchmark model framework, we first examine the independent effects of adjusting the upper and lower bound of contribution base on macroeconomic aggregates and income distribution (Table 4).

Table 4: Aggregate Results: Benchmark

	Benchmark	$\underline{\kappa} = 0.4$	$\underline{\kappa} = 0.8$	$\bar{\kappa} = 2$	$\bar{\kappa} = 4$
Interest Rate	6.627%	6.620%	6.589%	6.630%	6.627%
		-0.10%	-0.58%	0.04%	0.00%
Gini coefficient	0.450	0.451	0.446	0.450	0.450
		0.31%	-0.82%	0.08%	-0.01%
Trans	0.546	0.544	0.553	0.545	0.546
		-0.26%	**1.40%**	-0.17%	0.01%
Wage	1.894	1.895	1.898	1.893	1.894
		0.05%	0.23%	-0.01%	0.00%
Output	3.007	3.008	3.014	3.007	3.007
		0.04%	0.24%	-0.02%	0.00%
Capital	21.46	21.48	21.59	21.45	21.46
		0.10%	0.60%	-0.04%	0.00%
Consumption	2.823	2.791	2.889	2.817	2.823
		-1.14%	**2.34%**	-0.19%	0.01%
Tax Income	0.508	0.505	0.515	0.508	0.508
		-0.59%	1.25%	-0.03%	0.00%
Pension Deficit	-0.0084	-0.0070	-0.0072	-0.0092	-0.0084
		-16.84%	**-13.84%**	9.36%	**-0.32%**
Replacement Rate	0.47	0.45	0.49	0.47	0.47
		-2.81%	**5.48%**	-0.49%	0.03%
Contribution Rate	0.297	0.282	0.332	0.296	0.297
		-5.07%	11.67%	-0.34%	0.01%
Welfare Change	0.000%	-0.507%	**1.061%**	-0.080%	0.004%

Impact of Adjusting the upper bound. Limited Impact of Adjusting the upper bound, but with redistributional effects: Our simulation results show that adjusting the upper bound of contribution base has a negligible impact on macroeconomic aggregates. For instance, lowering the upper bound from 300% to 200% of the social average wage leaves aggregate output and consumption virtually unchanged. However, this policy has a negative redistributional effect: as high-income agents contribute less , the redistributive power of the system is weakened, leading to a 0.08% increase in the Gini coefficient and a slight widening of income inequality. Conversely, while raising the upper bound can modestly improve inequality and welfare by enhancing redistribution, its policy leverage is very limited because it affects only a very small fraction of high-income earners.

Impact of Adjusting the lower bound. Significant and Asymmetric Effects of Adjusting the lower bound: In contrast to the upper bound, adjusting the lower bound of contribution base has profound effects on the economy.

- Lowering the lower bound (from 0.6 to 0.4): This measure significantly reduces the contribution burden on low-income agents (a 5% drop in their contribution rate). However, the consequences are a "double-edged sword." On one hand, it alleviates the sustainability pressure on the pension system (reducing the deficit). On the other hand, it also lowers the future pension replacement rates for low-income agents, leading to a decline in both aggregate consumption and overall welfare.
- Raising the lower bound (from 0.6 to 0.8): Surprisingly, although this policy increases the immediate burden on low-income agents (an 11% rise in their contribution rate), it yields positive macroeconomic outcomes. The replacement rate is boosted, the pension deficit narrows, and the government's capacity for transfer payments is enhanced. This ultimately stimulates aggregate consumption and raises overall social welfare.

5.1.2. Mechanism Analysis

Redistribution of the Pension System. The model clearly demonstrates the system's redistributive effect. As shown in Figure 1[2], the current social security policy provides strong protection for agents with a low contribution base, whose benefit-to-contribution ratio is well above one, implying an implicit subsidy in their pension benefits. As the contribution base increases, this ratio gradually decreases. Since the contribution base is tied to wages and not subject to agent choice, this mechanism effectively mandates a transfer from high-income contributors to subsidize low-income beneficiaries, achieving significant wealth redistribution.

As illustrated in Figure 1, raising the lower bound of contribution base reduces the system's redistributive effect, as more agents fall into a lower benefit-to-contribution ratio range. The Gini coefficient analysis in Figure 2 confirms this: raising the lower bound, while increasing the income of the lowest earners (shifting the lower part of the Lorenz curve upward), can reduce the overall redistributive impact.

Furthermore, in the more detailed Gini coefficient Figure 3, which respectively illustrates the income inequality indices before and after contribution following the changes in the upper and lower bounds, it can be observed that the social security demonstrates a significant redistributive effect (the Gini coefficient after contribution is lower than that before contribution). Meanwhile, as the lower bound increases, the pension benefit-to-contribution ratio

[2]The figure plots the lifetime benefit-to-contribution ratio for a retiree against their average contribution base. The contribution component is the total lifetime pension contributions calculated based on the social average wage and the agent's average labor productivity during the contribution period. The benefit component is the total lifetime pension benefits received.

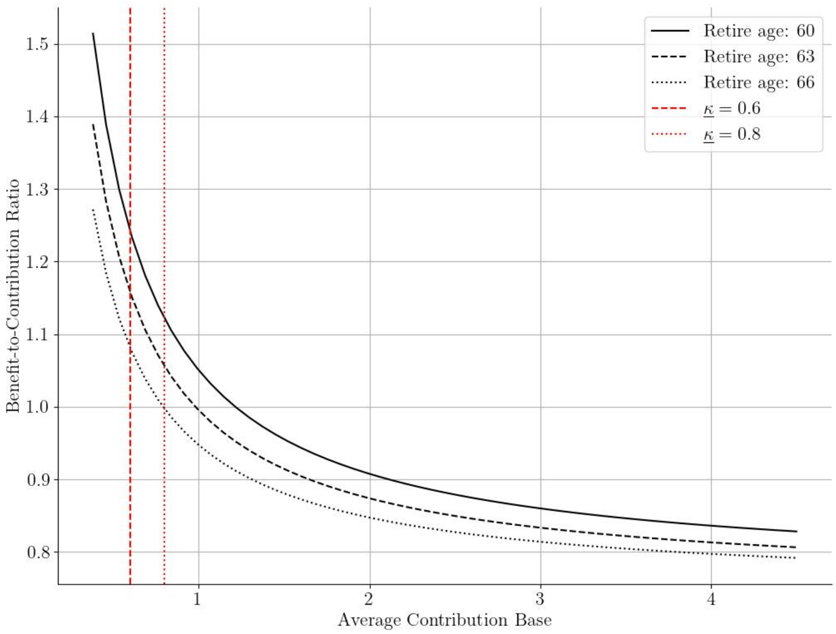


Fig. 1: Benefit-to-Contribution Ratio

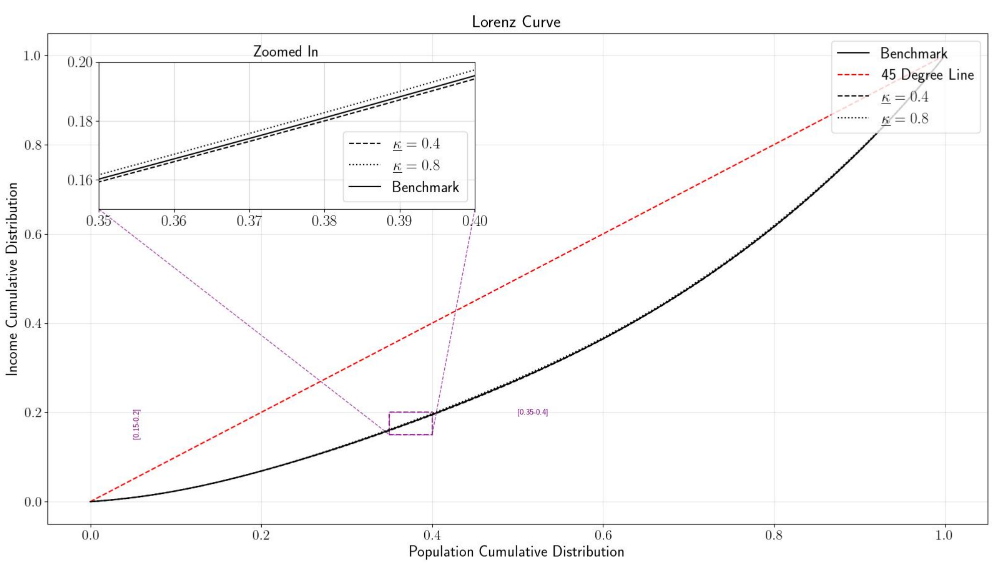
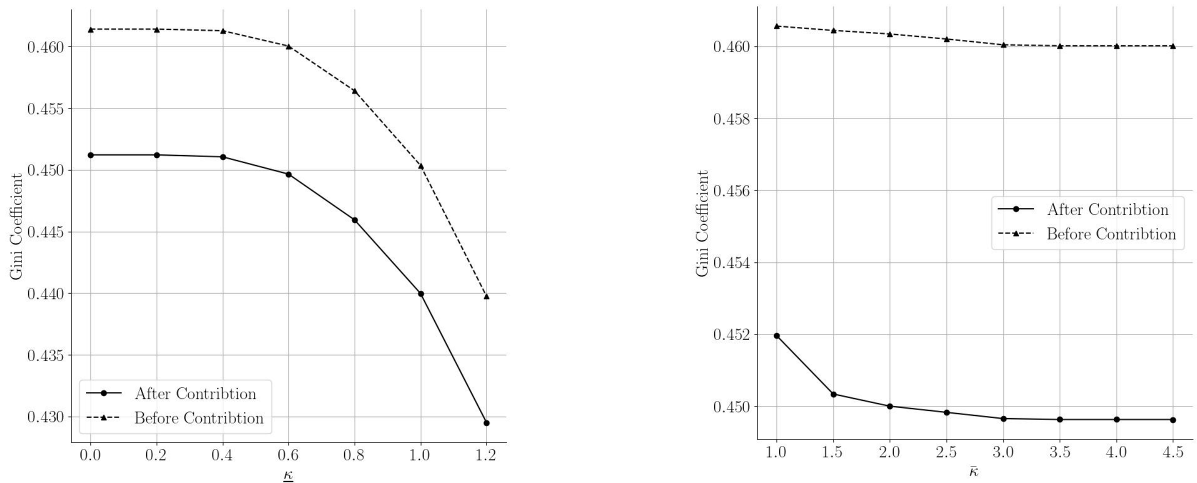


Fig. 2: Lorenz Curve Figure

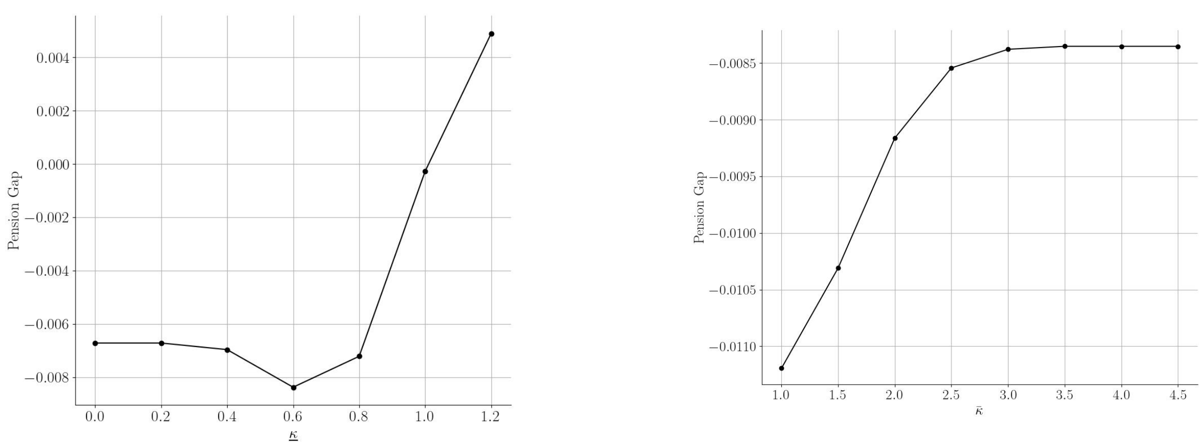
gradually decreases, leading to a reduction in the redistributive effect. Conversely, adjusting the upper bound has little effect on inequality unless it is lowered to a level (e.g., 100% of the average wage) that affects a majority of the population, in which case inequality increases.



Lower bound Upper bound

Fig. 3: Gini Coefficient Figure

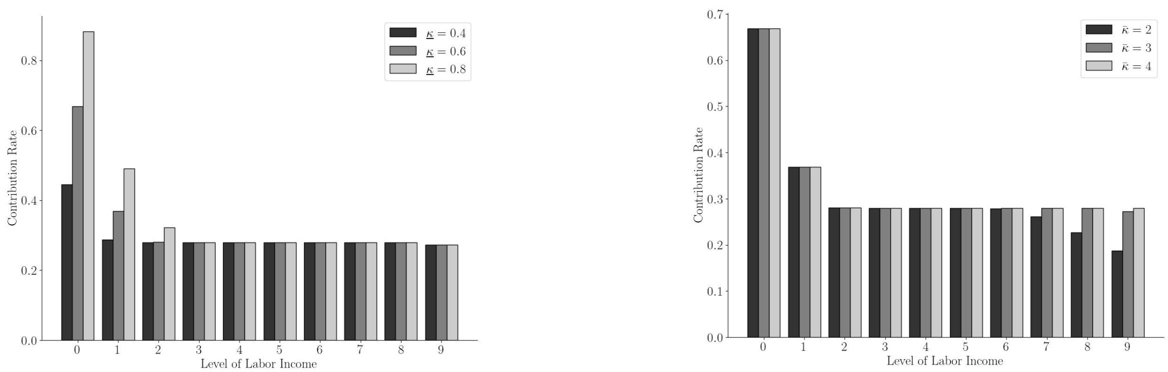
Impact on the Pension Deficit. As depicted in Figure 4, lowering the upper bound reduces contributions from high-income agents, thereby widening the deficit. However, if the upper bound is lowered below a certain threshold, it affects a large portion of the population, leading to a reduction in both contributions and benefits and an overall decrease in the deficit. Raising the lower bound increases both contributions and benefits for low-income agents but significantly raises their payment burden. Lowering the lower bound reduces both. Both types of floor adjustments, under our calibration, lead to a smaller pension deficit.



Lower bound Upper bound

Fig. 4: Pension Deficit Figure

Regressive Nature of Contributions. The model highlights that the regressive contribution mechanism significantly impacts the fairness of the pension system. This is primarily due to the lower bound of contribution: low-income agents earning below the lower bound must still contribute based on the lowest level, substantially increasing their effective contribution rate. Although the pension system has a redistributive function, this high contribution ratio can impose a heavy burden on low-income groups, potentially dampening their incentive to participate and thus affecting the system's coverage and sustainability. Our policy experiments show (Figure 5) that only by substantially lowering the contribution floor (e.g., to $\underline{\kappa} = 0.4$) can this institutional regressivity be eliminated, leading to a convergence of effective contribution rates across all income groups.



Lower bound Upper bound

Fig. 5: Regressive Contribution Rate

5.2. Introducing Flexible Delayed Retirement: Aggregate Gains and Heterogeneous Choices

Building on the benchmark model, we now introduce the core policy reform: allowing agents to make an endogenous, forward-looking choice to retire at age 60, 63, or 66.

5.2.1. Aggregate Results

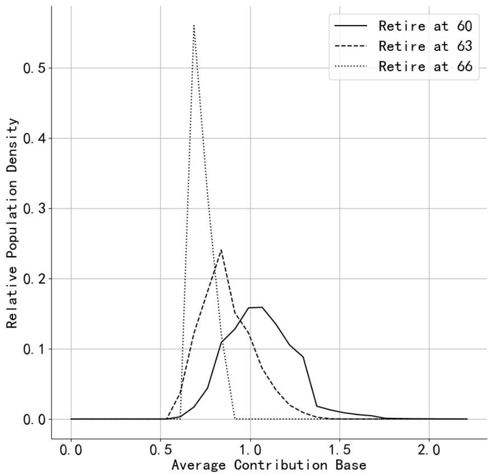
The introduction of a flexible retirement mechanism brings significant improvements on its own. As shown in Table 5, compared to the mandatory retirement scenario, flexible retirement enhances social welfare under all contribution base settings. More interestingly, it further alleviates the pressure on the social security account, with the pension deficit decreasing in all cases, by up to 17% in some scenarios. This is because agents can now use a new channel—delaying retirement—to respond to various shocks, and later pension claims also reduce payment pressures.

Table 5: Aggregate Results: Delay Retirement

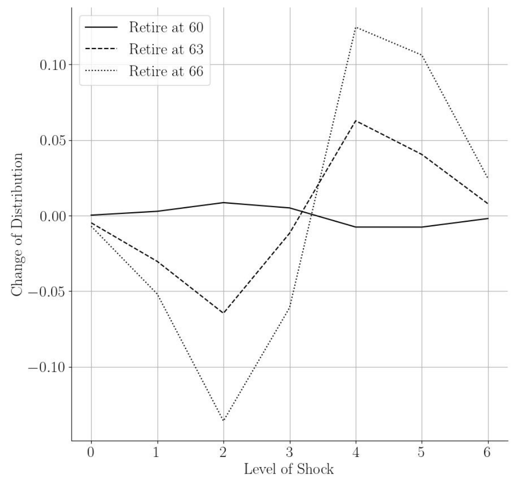
	Delayed Retire				
	$\underline{\kappa} = 0.4$	$\underline{\kappa} = 0.6$	$\underline{\kappa} = 0.8$	$\bar{\kappa} = 2$	$\bar{\kappa} = 4$
Interest Rate	0.066	0.066	0.066	0.066	0.066
	-0.18%	-0.12%	-0.04%	-0.15%	-0.12%
Gini coefficient	0.452	0.450	0.446	0.450	0.450
	0.21%	0.07%	0.00%	0.06%	0.04%
Trans	0.546	0.547	0.554	0.546	0.547
	0.29%	0.17%	0.04%	0.17%	0.17%
Wage	1.893	1.894	1.898	1.894	1.894
	-0.06%	0.01%	0.01%	0.02%	0.01%
Output	3.010	3.009	3.015	3.008	3.009
	0.07%	0.05%	0.01%	0.06%	0.06%
Capital	21.516	21.482	21.593	21.478	21.489
	0.18%	0.13%	0.04%	0.15%	0.15%
Consumption	2.796	2.826	2.890	2.821	2.827
	0.21%	0.12%	0.03%	0.13%	0.13%
Tax Income	0.506	0.509	0.515	0.509	0.509
	0.15%	0.09%	0.02%	0.09%	0.10%
Pension Deficit	-0.0058	-0.0078	-0.0071	-0.0086	-0.0078
	-17.33%	**-7.11%**	**-1.45%**	**-6.55%**	**-7.12%**
Replacement Rate	0.485	0.487	0.498	0.485	0.487
	6.81%	**4.14%**	**1.09%**	**4.22%**	**4.14%**
Contribution Rate	0.282	0.297	0.332	0.296	0.297
	0.01%	0.00%	0.00%	0.00%	0.00%
Welfare Change	**0.103%**	**0.063%**	**0.017%**	**0.068%**	**0.063%**
Retire at 60	90.9243%	95.6852%	99.2468%	95.6367%	95.6844%
Retire at 63	9.0689%	4.3147%	0.7532%	4.3631%	4.3154%
Retire at 66	0.0068%	0.0002%	0.0000%	0.0002%	0.0002%

5.2.2. Who Retire Early?

The macroeconomic effects of flexible retirement are driven by the activation of heterogeneous agent choices. A detailed analysis of simulated agent behavior (Figures) reveals:



Lower bound



Upper bound

Fig. 6: Retirement choice

The agents most likely to delay retirement are those who experience high productivity shocks but have a low average contribution base. For them, delaying retirement is highly incentivized as it allows them to capitalize on their current high productivity to earn more income and significantly increase their future pension level. Conversely, agents facing negative productivity shocks or those who have already accumulated a high contribution base lack the incentive to delay retirement.

5.2.3. Why is there a lower Pension Deficit?

Flexible retirement mitigates the pension deficit primarily by optimizing the system's benefit-contribution structure through agent choice. Agents who choose to delay retirement typically have a lower lifetime benefit-to-contribution ratio (as seen in Figure 1). When a policy (such as lowering the contribution floor) incentivizes more such agents to delay retirement, the system's average benefit-to-contribution ratio declines. This creates less payment pressure compared to a scenario where everyone retires at 60, effectively reducing the pension deficit.

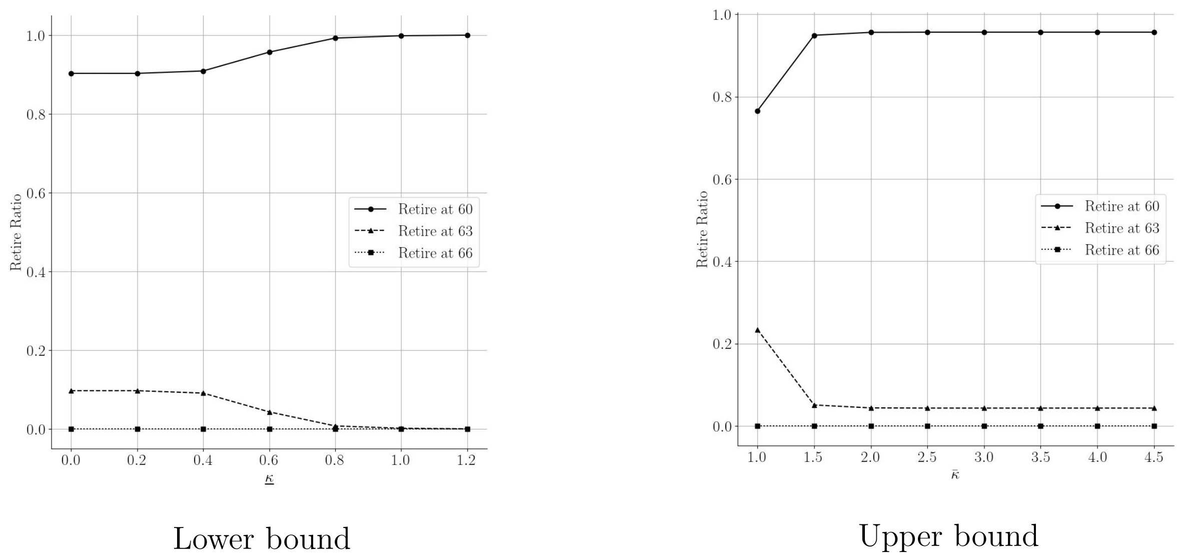


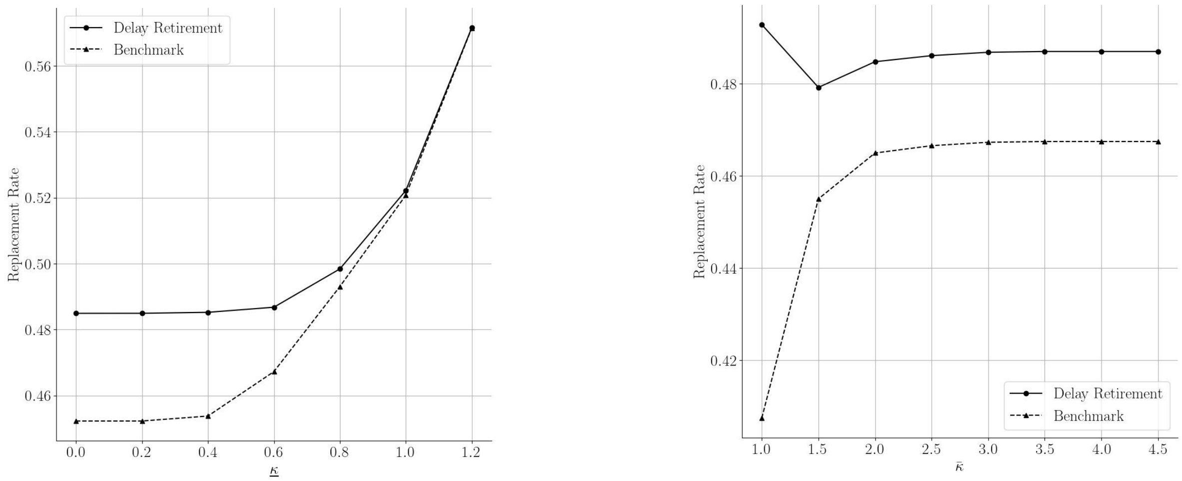
Fig. 7: Retirement age distribution

Furthermore, a lower contribution floor, by reducing lower income agents' average contribution base and thus their pension income, further incentivizes them to delay retirement to secure better old-age provisions (see Figure 7).

5.2.4. Policy Tools

The effectiveness of policy tools also changes within the flexible retirement framework.

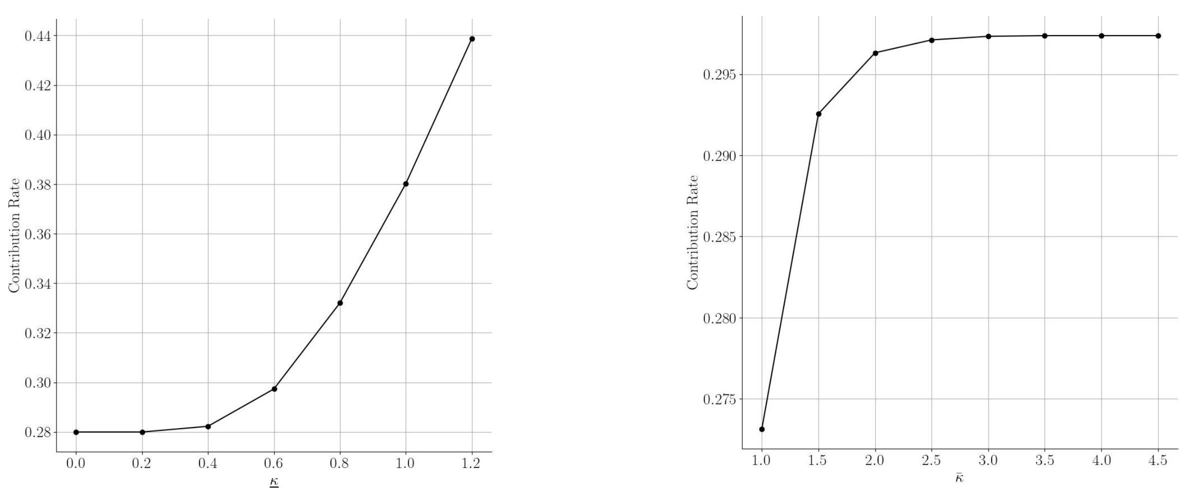
Enhancement of Replacement Rates. The pension replacement rate under a flexible retirement system is consistently higher than that under a mandatory retirement system (see Figure 8). While adjusting the upper bound has a minor effect on replacement rates, the advantage of the flexible system is clear and stable. The autonomy of choice under flexible retirement is particularly advantageous at low contribution floors, though the two systems converge as the floor is raised (as retirement choices become more uniform).



Lower bound   Upper bound

Fig. 8: Replacement Rate

Social Welfare or Equality?. Our experiments (Figure 9) confirm that lowering the lower bound of contribution is the most effective way to eliminate contribution-side regressivity and reduce inequality. However, adjusting the upper bound has little impact on the average contribution rate, and lowering it can even exacerbate contribution inequality. While adjusting the lower bound can balance the contribution burden across different income groups and promote institutional fairness, it may also reduce the welfare protection for low-income agents, thereby affecting aggregate social welfare.



Lower bound   Upper bound

Fig. 9: Contribution Rate

6. EXTENSION: THE EARLY CONTRIBUTION PAYMENT

Our benchmark model assumes that agents begin contributing to social security for $J_{contrib}$ years immediately preceding the minimum retirement age, a period that coincides with their peak life-cycle productivity. This assumption might overstate the rate of return on contributions and thus influence our policy evaluation, particularly the conclusions regarding adjustments to the contribution floor. To test the robustness of our main findings, we conduct a counterfactual experiment: we assume agents start contributing continuously from the moment they enter the labor market (i.e., at age 21).

The simulation results from this experiment are presented in Table 6.

Consistent with the benchmark model, adjusting the upper bound of contribution base continues to have limited macroeconomic effects. Lowering the upper bound slightly reduces welfare, while raising it slightly increases welfare. The main conclusion remains unchanged.

Under the early contribution scenario, raising the lower bound of contribution now leads to a decrease in welfare. The underlying mechanism is that when the contribution period covers an agent's less productive youth, a higher mandatory lower bound of contribution imposes a greater distortion on their life-cycle consumption and saving decisions. The redistributive effect on the benefit side is insufficient to fully compensate for this loss. Meanwhile, lowering the lower bound of contribution still results in a welfare decline, as it widens the pension deficit, forcing the government to cut transfer payments, which in turn reduces agents' aggregate income and consumption.

Table 6: Aggregate Results: Early Contribution

	$\underline{\kappa} = 0.4$	$\underline{\kappa} = 0.6$	$\underline{\kappa} = 0.8$	$\underline{\kappa} = 1.0$	$\bar{\kappa} = 2$	$\bar{\kappa} = 4$
Interest Rate	0.0807	0.0808	0.0807	0.0807	0.0807	0.0808
	-0.036%		-0.050%	-0.105%	-0.034%	-0.001%
Gini coefficient	0.4514	0.4519	0.4529	0.4566	0.4516	0.4519
	-0.109%		0.227%	1.049%	-0.065%	0.005%
Trans	0.5579	0.5600	0.5678	0.5815	0.5583	0.5601
	-0.375%		1.391%	3.837%	-0.303%	0.019%
Wage	1.7423	1.7421	1.7422	1.7428	1.7424	1.7421
	0.011%		0.010%	0.040%	0.018%	0.000%
Output	2.7663	2.7659	2.7661	2.7666	2.7663	2.7659
	0.015%		0.005%	0.025%	0.014%	0.000%
Capital	17.2866	17.2796	17.2820	17.2911	17.2860	17.2796
	0.040%		0.014%	0.067%	0.037%	0.000%
Consumption	3.2416	3.2725	3.3556	3.4568	3.2588	3.2739
	-0.944%		2.540%	5.632%	-0.418%	0.042%
Tax Income	0.5354	0.5383	0.5460	0.5553	0.5376	0.5384
	-0.541%		1.435%	3.161%	-0.137%	0.016%
Pension Deficit	0.0203	0.0201	0.0222	0.0286	0.0190	0.0202
	0.588%		10.137%	41.853%	-5.595%	0.219%
Replacement Rate	0.4662	0.4743	0.4958	0.5219	0.4707	0.4747
	-1.712%		4.526%	10.033%	-0.768%	0.075%
Contribution Rate	0.2811	0.2912	0.3190	0.3587	0.2898	0.2913
	-3.50%		9.545%	23.177%	-0.509%	0.029%
Welfare Change	**-0.0005**	0.0000	**-0.0001**	**-0.0043**	**-0.0005**	**0.0001**

This robustness check highlights the importance of contribution timing. It demonstrates that the welfare consequences of mandatory contribution policies (like the floor) are critically dependent on how well they align with the agent's life-cycle productivity profile.

Table 7: Aggregate Results: Early Contribution and Delay Retirement

	$\underline{\kappa} = 0.4$	$\underline{\kappa} = 0.6$	$\underline{\kappa} = 0.8$	$\bar{\kappa} = 2$	$\bar{\kappa} = 4$
Interest Rate	0.0807	0.0808	0.0807	0.0807	0.0808
	0.0028%	0.0000%	-0.0074%	-0.0001%	0.0001%
Gini coefficient	0.4514	0.4518	0.4529	0.4516	0.4518
	0.0148%	-0.0106%	0.0011%	-0.0003%	-0.0114%
Trans	0.5579	0.5599	0.5680	0.5584	0.5601
	0.0067%	-0.0076%	0.0333%	0.0121%	-0.0074%
Wage	1.7423	1.7420	1.7424	1.7424	1.7420
	0.0013%	-0.0054%	0.0115%	0.0028%	-0.0055%
Output	2.7663	2.7659	2.7660	2.7663	2.7659
	-0.0011%	-0.0013%	-0.0016%	0.0000%	-0.0004%
Capital	17.2861	17.2790	17.2813	17.2860	17.2794
	-0.0028%	-0.0035%	-0.0043%	0.0000%	-0.0012%
Comsumption	3.2401	3.2738	3.3559	3.2589	3.2752
	-0.0472%	0.0393%	0.0098%	0.0031%	0.0395%
Tax Income	0.5352	0.5384	0.5460	0.5376	0.5385
	-0.0269%	0.0221%	0.0032%	0.0018%	0.0228%
Pension Deficit	0.0204	0.0200	0.0222	0.0190	0.0201
	0.6373%	-0.5586%	-0.0388%	-0.0197%	-0.5565%
Replacement Rate	0.4661	0.4747	0.4958	0.4707	0.4750
	-0.0136%	0.0795%	0.0081%	0.0120%	0.0794%
Contribution Rate	0.2811	0.2912	0.3191	0.2898	0.2913
	0.0001%	-0.0010%	0.0035%	0.0006%	-0.0010%
Welfare Change	-0.0001	0.0001	0.0001	0.0000	0.0001
Retire at 60	0.9995	1.0000	1.0000	1.0000	1.0000
Retire at 63	0.0005	0.0000	0.0000	0.0000	0.0000
Retire at 66	0.0000	0.0000	0.0000	0.0000	0.0000

Further comparison of aggregate economic data between scenarios with and without flexible retirement (Tabel 7), under the counterfactual assumption of a early contribution period. In this scenario, we stipulate that all agents contribute for a fixed duration of $J_{contrib}$ years, starting from their entry into the labor market. Consequently, an agent's decision to delay retirement no longer extends their contribution period or increases the total contributions to the pension system. This decouples the retirement decision from the contribution duration, fundamentally altering the incentive structure. The primary benefit of delaying retirement is now limited to a longer period of wage-earning and the actuarial adjustment on pension benefits, without the added advantage of accumulating a larger pension pot through extended contributions. As a result, the welfare gains attributable to flexible retirement are significantly diminished compared to our benchmark model, and its overall impact on macroeconomic aggregates becomes marginal. This demonstrates that the effectiveness of a flexible retirement policy is not absolute; it is critically contingent on its interaction with other system rules, particularly those governing the duration and timing of contributions.

The Potential Value of Flexible Contributions: These results suggest that a more optimal institutional design may need to go beyond fixed contribution periods and timings. Allowing agents to flexibly choose the timing and intensity of their contributions based on their life-cycle income fluctuations (e.g., contributing more during high-wage periods or even allowing for limited contribution deferrals) could enhance agent welfare more effectively than simply adjusting the upper and lower bound. Exploring policies that combine such ”flexible contributions” with ”flexible retirement” presents a valuable direction for future research.

7. Conclusion

This paper confronts the pressing challenges of regressivity, inadequacy, and unsustainability facing China’s Urban Basic Pension System. By developing and calibrating a large-scale overlapping generations (OLG) model with rich institutional details—notably the non-linear contribution rules and an endogenous flexible retirement choice—we quantitatively evaluate the macroeconomic and distributional consequences of two central reform initiatives: adjusting the contribution base and introducing a flexible retirement system.

Our analysis yields several key findings. First, under a fixed retirement age, adjustments to the contribution base produce significant and asymmetric effects. Raising the upper bound has a negligible impact on macroeconomic aggregates and a limited redistributive effect. In contrast, adjusting the lower bound has profound consequences: lowering it acts as a ”double-edged sword,” easing the immediate burden on low-income groups but ultimately harming aggregate consumption and welfare by reducing their future replacement rates. Surprisingly, moderately raising the lower bound, despite increasing the immediate contribution burden, yields positive macroeconomic and welfare outcomes by boosting replacement rates and enhancing the system’s redistributive capacity.

Second, the introduction of a flexible retirement system, on its own, generates a significant Pareto improvement, enhancing social welfare while substantially reducing the pension deficit. This mechanism improves labor market efficiency by empowering agents to optimize their retirement timing in response to life-cycle events, such as productivity shocks. We find strong synergistic effects between flexible retirement and contribution base adjustments. For instance, under a flexible retirement framework, lowering the contribution floor incentivizes more agents with positive productivity shocks to delay retirement for higher pensions, which partially offsets the negative impact on replacement rates and further improves the system’s financial health.

However, these conclusions are critically reversed when we alter the contribution period from the years immediately preceding retirement to the entire career span starting from labor market entry (age 21). In this scenario, raising the lower contribution bound leads to a welfare decrease. The underlying mechanism is that forcing young, less productive agents to bear a higher contribution rate imposes a significant distortion on their life-cycle consumption and saving decisions, and the redistributive effect on the benefit side is insufficient to compensate for this loss. This finding provides a crucial insight: the welfare consequences of pension policies, particularly contribution rules, are highly dependent on how they align with agents’ life-cycle productivity profiles.

Based on these findings, this paper offers several policy recommendations. First, policy-makers should avoid one-size-fits-all approaches, exercising particular caution when adjusting the lower contribution bound and fully considering its life-cycle incentive and welfare effects on different income groups. Second, a flexible retirement system should be steadily promoted as an effective channel for optimizing resource allocation and enhancing system resilience.

Most importantly, future reforms should look beyond flexible retirement to explore a more comprehensive ”flexible contribution” framework. Allowing agents to adjust the timing and intensity of their contributions based on their life-cycle income fluctuations—for example, contributing more during high-income years and deferring contributions during low-income periods—and combining such ”flexible contributions” with ”flexible retirement” presents a more promising path toward a pension system that is financially sustainable, economically efficient, and distributionally equitable.

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