Delay the Pension Age or Adjust the Pension Benefit? Implications for Labor Supply and Individual Welfare in PRC

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Outline

1. Introduction
2. The model
3. Calibration
4. Baseline Results
5. Policy Experiments

Background

Rapid population aging in PRC

- Old-age dependency ratio: 18.5% in 2020 $\rightarrow$ 47.5% in 2050.
- Average life expectancy at birth: 77 in 2020 $\rightarrow$ 81.5 in 2050.

PRC's pension system

- Multi-layered, still on track to achieve universal coverage.
- Average pension age is lower than 55.
- Reform proposal: Gradually raising the pension eligibility age to age 65 for m/f covered by the Basic Old Age Insurance (BOAI) pension scheme.
- First proposed in 2012, details of the reform are still under discussion.
- Limited formal analysis of the implications of increasing the pension age on Chinese labor supply and individual welfare.

Background

BOAI: all workers

- 435 million participants in 2019 (incl. 123 million retirees).
- Social pooling program: 20% of employee's wage.
- Notional individual account: 8% of employee's wage.
- Eligibility age: 60 for males, 50 or 55 for females, minimum 15-year contribution.
- No delay claiming, labor income don't affect pension calculation beyond pension age.
- Requires subsidies from central and local governments to avoid deficit.
  - Direct fiscal subsidies: 18.4% (*RMB* 0.8 trillion) of total revenue in 2017.

This paper

- A life-cycle model of labor supply and consumption for Chinese urban males to quantify the implication of **three hypothetical reforms** on **labor supply, individual welfare, and government budget** for the BOAI:
  - (i) Increase the pension age from 60 to 65.
  - (ii) Proportionally reducing pension benefits $\rightarrow$ pension program's budget is the same as under Reform (i).
  - (iii) Simultaneously increase the pension eligibility age to 65 and proportionally increase pension benefits $\rightarrow$ both skill types attain the same individual welfare levels.
- Heterogeneous effects for **high-skilled and low-skilled-workers**.

This paper

- Data:
  - China Health and Retirement Longitudinal Study (CHARLS): bi-annual data, 3 waves (2011, 2013, 2015).
  - Chinese Longitudinal Healthy Longevity Survey (CLHLS): 1998-2012.
- Contribution
  - Ongoing policy debate in PRC about pension reforms.
  - Quantify the implications of the pension eligibility age/pension benefit in a single framework.
  - Closely approximates the current pension formula of the BOAI.
  - Quantify the heterogeneous effects of the different reforms by skill types.

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The life-cycle model: Overview

Model agents:

- 45-year-old urban males; maximum age 100,
- make (binary) labor supply and (continuous) consumption decisions in each period.

Two skill types: high-skilled $(s = h)$ and low-skilled $(s = l)$.
Health Dynamics: $H_t \in \{g, b, d\}$

- Two transient states, good health (g) and bad health (b), and one absorbing state, death (d).

The life-cycle model: continued

- Medical expenses

$$\tilde{M}_t^s(H_t) = \begin{cases} 0, & \text{with probability } p_0^s(H_t)\ , \\ m_{H_t}^s, & \text{with probability } 1 - p_0^s(H_t)\ . \end{cases} \tag{1}$$

- Within-period utility:

$$u^s(C_t, H_t, \tau_t) = \frac{1}{1-\gamma}\left[C_t^{\alpha^s}\left(1 - \omega_{H_t}^s \tau_t\right)^{(1-\alpha^s)}\right]^{1-\gamma}, \tag{2}$$

$$\tau_t = 0, \text{ for } t + 45 \geq 75. \tag{3}$$

- Bequest motive

$$v^s(W_t) = \theta \frac{(W_t + \kappa)^{\alpha^s(1-\gamma)}}{1-\gamma}, \tag{4}$$

- Labor income L_t^s, for $H_t \in \{g, b\}$:

$$\ln(L_t^s) = l_t^s(H_t) + \bar{\mu}^s + \lambda_t^s + \mu_t^s, \tag{5}$$

$$l_t^s(H_t) = \beta_0^s + \beta_1^s t + \beta_2^s t^2 + \beta_3^s t^3 + (\beta_4^s + \beta_5^s t + \beta_6^s t^2) I_{H_t=b}, \tag{6}$$

$$\mu_t^s = \rho^s \mu_{t-1}^s + \eta_t^s, \quad \rho^s \in [0, 1], \quad \eta_t^s \sim N(0, \sigma_{\eta^s}^2). \tag{7}$$

Pension income

- Approximate the statutory pension benefit P^* using P.
- P is a linear function of the average wage over an individual's career, $\bar{w}_t$, and number of years an individual has worked, y_t, before pension eligibility age.
- Assume that each person has worked 20 years before age 45, with $y_0 = 20$.
- Approximation explains over 96% of the variations in P^*.
- P is determined at the statutory pension age (currently 60 for males) and remains constant after that:

$$P = \begin{cases} 0, & \text{if } t + 45 < 60, \\ P(\bar{w}_t, y_t), & \text{if } t + 45 \geq 60, \end{cases} \tag{8}$$

$$P(\bar{w}_t, y_t) = \beta_{p0} + \beta_{p1}\bar{w}_t + \beta_{p2}y_t + \beta_{p3}\bar{w}_t^2 + \beta_{p4}\bar{w}_t^3 + \beta_{p5}\bar{w}_t^4 + \beta_{p6}\bar{w}_t y_t. \tag{9}$$

$$y_t = \begin{cases} y_{t-1} + 1, & \text{if } t + 45 < 60 \ \ \& \ \ \tau_t = 1, \\ y_{t-1}, & \text{if } t + 45 \geq 60 \text{ or } (t + 45 < 60 \ \ \& \ \ \tau_t = 0), \end{cases} \tag{10}$$

$$\bar{w}_t = \begin{cases} \frac{\bar{w}_{t-1}y_{t-1} + L_t^s}{y_t}, & \text{if } t + 45 < 60 \ \ \& \ \ \tau_t = 1, \\ \bar{w}_{t-1}, & \text{if } t + 45 \geq 60 \text{ or } (t + 45 < 60 \ \ \& \ \ \tau_t = 0). \end{cases} \tag{11}$$

Budget Constraints

- Total income Y_t^s is the sum of labor income L_t^s and pension benefits P, where $Y_t^s = L_t^s + P$.
- C^f: consumption floor
$$C_t \geq C^f, \tag{12}$$
- Following Hubbard et al. (1995) and French and Jones (2011), government transfer G_t is given by
$$G_t = \max\left\{0, C^f - (W_t + Y_t^s - \tilde{M}_t^s)\right\}. \tag{13}$$
- After-consumption wealth $\overline{W}_t$
$$\overline{W}_t = W_t + Y_t^s - \tilde{M}_t^s + G_t - C_t \geq 0. \tag{14}$$
- With rate of return r, the wealth dynamics are given by
$$W_{t+1} = \begin{cases} \overline{W}_t(1+r), & \text{if } G_t = 0, \\ 0, & \text{if } G_t > 0. \end{cases} \tag{15}$$

Recursive Formulation

$$V_t^s(X_t) = \max_{\{\tau_t, C_t\}} \left\{ u^s(C_t, H_t, \tau_t) + \delta \mathbb{E}_t \left[\sum_{H_{t+1} \in \{g,b\}} \pi_t^s(H_t, H_{t+1}) V_{t+1}^s(\mathbf{X}_{t+1} | \mathbf{X}_t, \tau_t, C_t) + \pi_t^s(H_t, d) v^s(W_{t+1}) \right] \right\} \tag{16}$$

subject to constraints (3), (12), (13), (14), and (15), and states evolutions (6)-(11), where $\mathbf{X}_t \equiv \{W_t, H_t, \bar{w}_t, y_t, \bar{\mu}^s, \lambda_t^s, \mu_t^s\}$, and δ is the discount factor.

- Solved numerically by backward induction.
- Use discrete-continuous endogenous grid-point method (DC-EGM) algorithm (Iskhakov et al., 2017).

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- Two-step calibration strategy:
  - In the first step, we calibrate several parameters outside the model, including health transitions, mortality rates, out-of-pocket medical expenses, and parameters to approximate pension benefits.
  - In the second step, we calibrate the remaining parameters within the model.
- We fit our model to the following moments: 70 data moments using CHARLS.
  - (i) average labor force participation rates
  - (ii) average consumption levels
  - (iii) variance of average log incomes
  - (iv) average labor income
  - (v) average wealth
  - (vi) average wealth to average labor income ratio

Model Fixed Parameters

Parameter	Description	Values
δ	Time discount factor	0.96
r	Risk-free interest rate	0.04
C^f	Consumption floor in *RMB*	1,774
γ	Coefficient of relative risk aversion, utility	2
κ	Bequest shifter, in thousands	215
θ	Bequest intensity, in thousands	2.36

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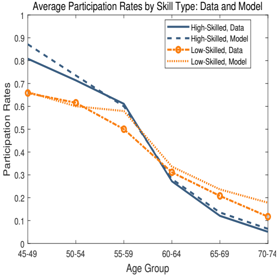
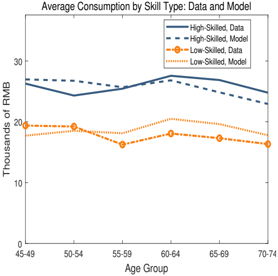
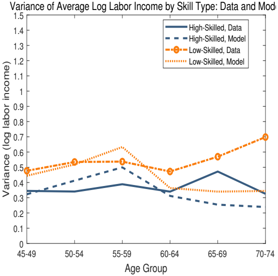
Calibrated Parameters

Parameters	Description	Values	
		High-Skilled	Low-Skilled
Panel A: Parameters in the Utility Function [Equation (2)]:			
ω_g^s	Disutility of work, good health	0.326	0.37
ω_b^s	Disutility of work, bad health	0.348	0.396
α^s	Consumption weight	0.31	0.31
Panel B: Parameters for the Labor Income Process [Equations (5)-(7)]:			
$\sigma^2_{\eta^s}$	Variance of innovation	0.2116	0.1354
$\sigma^2_{\lambda^s}$	Variance of transitory shocks	0.1024	0.1681
$\sigma^2_{\bar{\mu}^s}$	Variance of individual fixed effect	0.0004	0.1318
ρ^s	Autoregressive coefficient	0.86	0.905
β_0^s	Constant	2.38	2.28
β_1^s	Age coefficient	0.119	0.071
β_2^s	Age squared coefficient	-0.0024	-0.0017
β_3^s	Age cubed coefficient	0.000007	0.0000079
β_4^s	Bad health coefficient	0.393	0.042
β_5^s	Bad health $*$ age coefficient	-0.028	-0.005
β_6^s	Bad health $*$ age squared coefficient	0.00015	-0.00016

Data Patterns and Model Fit







Data source: CHARLS.

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Policy Experiments

- Reform (i): Raise the pension age from 60 to 65.
- Reform (ii): Keep pension age at 60 but reduce the annual pension benefits by a proportional factor ($\rho_2 \in (0, 1)$) such that the impact of Reform (ii) on the budget of the pension program's budget is the same as Reform (i).
- Reform (iii): Simultaneously raise the pension eligibility age to 65 and increase pension benefits proportionally ($\rho_3^s > 1$) such that individual welfare for each skill type is the same as that in the status quo.

Effects of Reforms on Labor Supply

	High-Skilled			Low-Skilled		
	Baseline	Reform (i)	Diff.	Baseline	Reform (i)	Diff.
Avg. retirement age	64.20	64.72	0.52	66.27	66.48	0.21
Avg. working years	13.33	14.00	0.67	12.63	12.41	-0.22
LFPR during 60–64 (%)	28.18	41.45	13.27	33.62	45.61	11.99
	Baseline	Reform (ii)	Diff.	Baseline	Reform (ii)	Diff.
Avg. retirement age	64.20	65.06	0.86	66.27	66.91	0.63
Avg. working years	13.33	13.84	0.51	12.63	12.86	0.22
LFPR during 60-64 (%)	28.18	32.57	4.39	33.62	36.28	2.66
	Baseline	Reform (iii)	Diff.	Baseline	Reform (iii)	Diff.
Avg. retirement age	64.20	64.21	0.01	66.27	65.77	-0.51
Avg. working years	13.33	13.8	0.47	12.63	12.00	-0.63
LFPR during 60–64 (%)	28.18	41.12	12.94	33.62	43.52	9.9

Notes: *LFPR=labor force participation rate. Baseline: all individuals receive pension benefits at age 60. Reform (i): increases the pension eligibility age from 60 to 65. Reform (ii): proportionally reduces pension benefits per annum, so that the pension program's budget is the same as in Reform (i). Reform (iii): simultaneously increases the pension eligibility age to 65 and proportionally increases annual pension benefits, so that both skill types maintain the same welfare level as the baseline level. Avg. retirement age refers to the average age at which an individual exits the labor market completely. Avg. working years are the number of years an individual has worked between age 45 and the compulsory retirement age of 75.

- The high-skilled will increase their number of working years between 45-75 under all three reforms.
- The low-skilled only increase their number of working years under Reform (ii).
- Reform (ii), reduces pension benefits, has the largest positive effect on overall labor supply.

Impact of Three Reforms on the Pension System Budget (in RMB)

	High-Skilled			Low-Skilled			Overall
	Cont45+	Payout	Net	Cont45+	Payout	Net	
Baseline	155,397.2	313,795.1	-158,397.9	104,433.8	200,665.2	-96,231.3	-112,394.6
Reform (i)	169,552.4	261,159.5	-91,607.1	115,928.2	168,769.1	-52,840.8	-62,920.0
Reform (ii)	155,295.1	242,507.2	-87,212.1	103,929.9	158,323.4	-54,393.6	-62,926.4
Reform (iii)	169,344.5	329,701.2	-160,356.7	114,989.1	202,252.5	-87,263.4	-106,267.6

Notes: All values are properly discounted or compounded to age 60 for fair comparison. The column labeled "Net" is Payout minus the contribution from 45 onward ("Cont45+"). The column labeled "Overall" is the weighted net values of high-skilled and low-skilled with the weight of high-skilled being 26%.

- Reforms (i) significantly improves the pension system's budget by increasing the pension contributions and reducing the pension payout for both skill types.
- Reform (ii) achieves the same overall budget improvement for the pension program as Reform (i) relative to that of the baseline.
- Reform (iii) modestly improve the budget of the pension system by both increasing the contributions to and the payouts from the pension system for both skill types.

Summary

- Reform (i): raise the pension eligibility age to 65
  - slightly increase the overall labor supply
  - cut the shortfall of the pension system by about 44% at the cost of significant individual welfare loss for both skill types.
- Reform (ii): proportionally reduce the pension benefit ($\rho_2^* = 0.6685$)
  - largest overall labor supply effect.
  - significantly improves the pension system's budget at the cost of greatest welfare loss for both skill types.
- Reform (iii): simultaneously raise the pension age and proportionally increase the annual pension benefit ($\rho_3^{l^*} = 1.204$ and $\rho_3^{h^*} = 1.263$)
  - ensures that both skill types achieve the same expected lifetime welfare as in the baseline case.
  - cut the shortfall of the pension system by about 5.5%.
  - slightly decrease the overall labor supply

Conclusion

- We develop a heterogeneous-agent life-cycle model to evaluate the implications of three pension reforms to the BOAI pension program on the labor supply and individual welfare of Chinese urban males age 45 and older.
  - Our model successfully replicates the labor supply and consumption behavior of individuals with heterogeneous skill types.
- The preferred pension reform critically depends on policymakers' objectives:
  - Increase labor supply and improve the financial sustainability of the BOAI pension program: reducing pension benefits.
  - Improve the budget of the pension program while ensuring that both skill types are not made worse off: a combined reform that *simultaneously* increases the pension eligibility age and proportionally raises the pension benefits may be an option to pursue.

Thank you!

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