Delay the Pension Age or Reduce the Pension Benefit? Implications for labor force participation and individual welfare

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31 December, 2019
Outline

1. Introduction
2. The life-cycle model
3. Estimation and Data
4. Next Step
Background

China’s public pension system:

- **Basic Old Age Insurance (BOAI):** employees in firms and public sectors
- Resident Pension: urban and rural residents

Basic Old Age Insurance:

- Coverage in 2018: 418.5 million participants
  - PAYG: 20% of employee’s wage
  - Individual account: 8% of employee’s wage
- Target replacement rate: 59.2%
- Eligibility age:
  - by law: 60 for males, 55 for white collar women and 50 for blue collar women
Motivation

Policy change:
- Gradually raising the public pension age (‘retirement age’) to age 65.
- Main objectives:
  ▶ Improve sustainability of the pension system
  ▶ Encourage people to work longer
Research questions

What are the effects of delaying the pension eligibility age in China on:

- labor force participation
- consumption
- individual welfare

for heterogeneous agents?

The effects of delaying pension age on the fiscal balance of the BOAI
Literature review

One representative agent


But: do not take into account the heterogeneity among workers

Structural models allowing for heterogeneity

- French and Jones, 2011; Laun and Wallenuis, 2015, 2016; Laun et al., 2018; Börsch-Supan et al., 2018

But: focus on the United States and Europe
Literature review

In China

- Giles et al. (2012, 2015): show empirically that there is a strong association between pension eligibility age and exit from the labor force.
- Jin (2016): structural model that studies the labor supply among older women in China and analyzes the effects of increasing the female pension age to 60.

There are currently no micro-level structural models quantifying the impact of the proposed increase in the statutory retirement age in China.
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The life-cycle model: Overview

**Two skill typers:** high-skilled and low-skilled: \( s = \{ h, l \} \)

**For each group:**
- urban males, age 45 with known health, wealth, income; maximum age 100
- derive utility from consumption, incur disutility from working
- bequest motives
- make (binary) labor supply and (continuous) consumption decisions in each period
Health dynamics

Three health states: Similar to Fong et al. (2015)

- **G**: good health, $H_t = g$
  - no limitation in performing any Activities of Daily Living; and
  - self-reported health better than “Poor”
- **P**: poor health, $H_t = p$
- **D**: dead, $H_t = d$

The transition probabilities are modelled as polynomial functions of age
Labor supply

- $\tau_t$ denotes the employment status

\[ \tau_t = \begin{cases} 
1, & \text{if working in period } t; \\
0, & \text{if not working in period } t.
\end{cases} \]  

- Compulsory retirement at age 75

\[ \tau_t = 0, \text{ for } t + 45 \geq 75. \]
Preference

- Cobb-Douglas function of consumption and leisure:

\[
u(C_t, \tau_t, H_t) = \frac{1}{1 - \gamma} \left[ C_t^\alpha \left( 1 - \omega(H_t, \tau_t) \left( 1 - \alpha \right) \right) \right]^{1 - \gamma}
\]  

(3)

- \(\gamma\): relative risk aversion
- \(C_t\): consumption of non-medical goods
- \(\omega(H_t, s)\): loss of leisure from work, total amount normalized to 1

\[
\omega(H_t, s) = \begin{cases} 
\omega_1, & \text{for } H_t = g; \\
\omega_2, & \text{for } H_t = p.
\end{cases}
\]

(4)
Bequest motive: De Nardi (2004), French and Johns (2011)

\[ v(W_t) = \theta - \gamma \frac{(W_t + \kappa)^{\alpha(1-\gamma)}}{1 - \gamma}, \]  

- \( \theta \): strength of the bequest motive
- \( \kappa \): the extent to which bequests are luxury goods

Subjective discount factor: \( \beta \)
Out-of-pocket healthcare expenditure

Following Ameriks et al. (2011) but allow the possibility of zero healthcare expenditure:

\[ M_t(s) = \begin{cases} 
0, & \text{with probability } p(H_t, s); \\
m(H_t, s), & \text{with probability } 1-p(H_t, s) 
\end{cases} \]  
(6)

where

\[ m(H_t, s) = \begin{cases} 
m1, & \text{if } H_t=g; \\
m2, & \text{if } H_t=p; \\
m3, & \text{if } H_t=d; 
\end{cases} \]  
(7)
Labor income

- Labor earnings $L_t$ in period $t$ (Yu and Zhu, 2013, Capatina, 2015)

$$\log(L_t) = l(H_t, t) + \bar{\mu} + \lambda_t + \mu_t,$$

$$l(H_t, t) = \beta_0(s) + \beta_1(s)t + \beta_2(s)t^2 + \beta_3(s)I_{H_t=p},$$

$$\mu_t = \rho(s)\mu_{t-1} + \eta_t.$$  \hspace{1cm} (8), (9), (10)

- deterministic part $l(H_t, t)$: function of age and health
- stochastic part:
  - ex ante heterogeneity $\bar{\mu} \sim N(0, \sigma_{\bar{\mu}}^2(s))$, given at birth
  - idiosyncratic transitory shock $\lambda_t \sim N(0, \sigma_{\lambda_t}^2(s))$
  - persistent shock $\mu_t$, an AR(1) process with $\eta_t \sim N(0, \sigma_{\eta_t}^2(s))$
Pension income

In practice, pension income $P(t, s)$ depends on
- individual wage history before retirement
- province average wage of all workers
- the ratio of the above two during all working years

In our model: given eligibility age $X$ (the policy parameter, currently 60), pension income is modeled as a linear function of $\bar{w}_t$ and $y_t$

$$P_t(s) = \begin{cases} 
0, & \text{if } t + 45 < X. \\
P(\bar{w}_t, y_t) & \text{if } t + 45 \geq X. 
\end{cases} \quad \forall t = 0, 1, 2, \ldots, T - 1.$$  (11)
Pension income

\[ y_t = \begin{cases} 
  y_{t-1}, & \text{if } t + 45 \geq X. \\
  y_{t-1} + 1, & \text{if } t + 45 < X \text{ and } \tau_t = 1.
\end{cases} \quad \forall t = 0, 1, 2, \ldots, T - 1. \tag{12} \]

\[ \bar{w}_t = \begin{cases} 
  \frac{\bar{w}_{t-1}y_{t-1}+L_t}{y_t}, & \text{if } t + 45 < x \text{ and } \tau_t = 1. \\
  \bar{w}_{t-1}, & \text{if } t + 45 \geq x.
\end{cases} \quad \forall t = 0, 1, 2, \ldots, T - 1. \tag{13} \]
Budget Constraints

Total income:

\[ Y_t = L_t + P_t \quad \forall t = 0, 1, 2, \ldots, T - 1. \]  (14)

Consumption floor and government transfer

\[ C_t \geq C^f \quad \forall t = 0, 1, 2, \ldots, T - 1, \]  (15)

\[ G_t = \max \{0, C^f - (W_t + Y_t - M_t)\} \quad \forall t = 0, 1, 2, \ldots, T - 1. \]  (16)

Budget constraint for after-consumption wealth

\[ \overline{W}_t = W_t + Y_t - M_t + G_t - C_t \geq 0 \quad \forall t = 0, 1, 2, \ldots, T - 1. \]  (17)

Wealth dynamics

\[ W_{t+1} = \begin{cases} \overline{W}_t(1 + r), & \text{if } G_t = 0 \quad \forall t = 0, 1, 2, \ldots, T - 1; \\ 0, & \text{if } G_t > 0 \quad \forall t = 0, 1, 2, \ldots, T - 1. \end{cases} \]  (18)
The optimization problem

- Receive pension income if age $\geq X$
- Pay out-of-pocket healthcare expenditure $M_t$
- Make labour supply decision $\tau_t$
- Choose consumption $C_t$ (subject to consumption floor $C^f$)
- State variables: $P_t = \{W_t, H_t, \bar{w}_t, y_t, \mu_{t-1}\}$
- Objective function

$$V_0(P_0) = \max_{\{\tau_t, C_t\}_{t=0}^{T-1}} \left\{ \mathbb{E}_0 \left[ \sum_{t=0}^{T-1} \sum_{j=p,g} \pi_0^t(H_0, j) \beta^t [u(C_t, H_t, \tau_t) + \beta \pi_t(j, d) v(W_{t+1})] \right] \right\} , \quad (19)$$

- The Bellman equation: subject to Equations (15), (17), (18) and (2).

$$V_t(P_t) = \max_{\{\tau_t, C_t\}} \left\{ u(C_t, H_t, \tau_t) + \sum_{j=p,g} \pi_t(H_t, j) \beta V_{t+1}(W_{t+1}, H_{t+1} = j, Y_{t+1}) + \pi_t(H_t, d) \beta v(W_{t+1}) \right\} , \quad (20)$$
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Data

- China Health and Retirement Longitudinal Study (CHARLS): a nationally representative sample of Chinese residents aged 45 and older
- Bi-annual data, 3 waves (2011, 2013, 2015)
- 11,097 person-year observations
Health dynamics: Estimation

Figure: Predicted percentage of men in poor health by age and skill type
Health dynamics: Estimation

Figure: Predicted percentage of men alive by age and skill type
# Out-of-pocket healthcare expenditure: in RMB

<table>
<thead>
<tr>
<th>Health Status</th>
<th>High-Skilled</th>
<th>Low-Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>6,166</td>
<td>4,441</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>21,424</td>
<td>14,496</td>
</tr>
<tr>
<td>99th percentile</td>
<td>113,400</td>
<td>60,360</td>
</tr>
<tr>
<td>Proportion of zero OOP costs</td>
<td>50.6%</td>
<td>51.0%</td>
</tr>
<tr>
<td><strong>Bad Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>18,251</td>
<td>13,644</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>54,932</td>
<td>46,163</td>
</tr>
<tr>
<td>99th percentile</td>
<td>137,360</td>
<td>138,800</td>
</tr>
<tr>
<td>Proportion of zero OOP costs</td>
<td>18.9%</td>
<td>22.2%</td>
</tr>
<tr>
<td><strong>Death</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>69,475</td>
<td>36,701</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>71,624</td>
<td>84,837</td>
</tr>
<tr>
<td>99th percentile</td>
<td>200,000</td>
<td>500,000</td>
</tr>
<tr>
<td>Proportion of zero OOP costs</td>
<td>4.9%</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

Notes: The OOP costs for death is estimated from the exit survey of CHARLS 2013.
## Initial Conditions

<table>
<thead>
<tr>
<th></th>
<th>High-Skilled</th>
<th>Low-Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wealth (in thousands of RMB)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>17.44</td>
<td>10.57</td>
</tr>
<tr>
<td><strong>Wage (in thousands of RMB)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>24.73</td>
<td>20.68</td>
</tr>
<tr>
<td><strong>Years worked before age 45</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td><strong>% in good health</strong></td>
<td>89.95%</td>
<td>85.98%</td>
</tr>
<tr>
<td><strong>% in bad health</strong></td>
<td>10.05%</td>
<td>14.02%</td>
</tr>
<tr>
<td><strong>% working</strong></td>
<td>76.19%</td>
<td>64.84%</td>
</tr>
</tbody>
</table>
Solved numerically by backward induction, EGM (Carroll, 2006) to construct grids for after-consumption wealth

Two-step strategy to estimate our model
  ▶ health transition matrix, mortality rate, out of pocket expenditure, and parameters to approximate pension income
  ▶ all the remaining parameters within the model
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Next steps

- Calibration: optimal parameters
- Calibration moments: average labor supply, wealth, labor income and variance of log earnings by skill type
- Policy experiment: increase pension age or reduce pension benefit?