Females, the Elderly, and Also Males: Demographic Aging and Macroeconomy in Japan

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1 Motivation

2 Model

3 Numerical Analysis
   Baseline
   Senarios

4 Conclusion
Age distribution in Japan (2017)

(in thousands)

Source: IPSS (2017)
Population (data and projections)

Source: IPSS (2017)
Old-age dependency ratio (age 65 up/20-64)

Motivation

• How is Japan going to handle a dramatic shift in its demographic structure and a rising fiscal burden associated with old-age transfer programs?

→ Japanese government is keen on encouraging labor force participation of females and the elderly.

↔ But, the effect is unknown.

In this paper,
• focusing on labor market trend and various scenarios of males, females and the elderly as well as the distribution of employment types.
• quantifying effects affecting macroeconomic variables and fiscal situations in Japan.
Related Literature

• Braun and Joines (2015), Kitao (2015), Hansen and Imrohoroglu (2016)
  • A life-cycle model with endogenous labor supply
    → But, abstracts from differences in gender, employment types and productivity difference gap.

• Hoshi and Ito (2014), Imrohoroglu, Kitao and Yamada (2018)
  • Generational accounting models
    → PE and exogenous policy.
Labor force participation rates

Earnings (workers)

Source: Basic Survey on Wage Structure (2015), normalized by age-20 male earnings
Participation rates by employment types

Source: LFS (2015)
Earnings by gender and employment type

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What we do

• Quantify how exogenous changes in the labor market affect macroeconomy and fiscal situations.
  • A simplest OLG model of a complete market with genders.
  • Exogenous changes in labor participation, employment types and productivity
  • Earnings profile given by the average labor productivity of each gender and age.

• We do not explain life-cycle profiles of labor supply and productivity gaps.

• Do this in a standard model of individuals, competitive firms and the government.
Model: Individual

- **Age**: \( i \in \{1, \cdots, I\} \) (20-104 years old)
- **Time**: \( t \in \{1, \cdots, T\} \) (1990 - 2500)
- **Gender**: \( g \in \{m, f\} \)
Model: Individual

- Demographics
  - $\mu_{i,g,t}$: Number of individuals of age $i$, gender $g$, at time $t$
  - $S_{i,g,t}$: Unconditional survival probability
  - $n_{g,t}$: Growth rate of a new cohort $\mu_{i,g,t}$
  - Use the official demographic projection of the IPSS (medium)

- Accidental bequests are given to all survivors as a lump-sum transfer, $b_t$
Model: Individual

• Preference

\[ u(c_{i,g,t}) = \frac{c_{i,g,t}^{1-\theta}}{1 - \theta} \]

• Life-time utility

\[ U_{g,t} = \sum_{i=1}^{I} \beta^{i-1} S_{i,g,t+i-1} \frac{c_{i,g,t+i-1}^{1-\theta}}{1 - \theta} \]

• Risk aversion: \( \theta = 2.0 \)
• Discount factor: \( \beta \) set s.t \( K/Y = 3.2 \) (average during 2010-2014)
Model: labor market

- Earnings of age $i$, year $t$, gender $g$: $\epsilon_{i,g,t} \times w_t$

- $\epsilon_{i,g,t}$: average labor productivity
  - Average efficiency units provided by an individual of age $i$, in year $t$, gender $g$
  - Computed based on data of participation rates, employment type and productivity

- $w_t$: Market wage per efficiency unit = MPL
Model: labor market

- How to compute $\epsilon_{i,g,t}$?
  - Use micro data (LFS, BSWS and ESS) for the age and gender specific distribution of employment types (R/C/S), $\mu^R_{i,g,t}, \mu^C_{i,g,t}, \mu^S_{i,g,t}$ and productivity $y^R_{i,g,t}, y^C_{i,g,t}, y^S_{i,g,t}$

\[
\epsilon_{i,g,t} = \left( y^R_{i,g,t} \mu^R_{i,g,t} + y^C_{i,g,t} \mu^C_{i,g,t} + y^S_{i,g,t} \mu^S_{i,g,t} \right) / \mu_{i,g,t}
\]
Model: Efficiency Units: $\epsilon_{i,g,t}$

Normalized by the male level at 20
Model: the government

- Revenues
  - Proportional tax
    - Consumption tax: $\tau_{c,t} \ 8\% \rightarrow 10\% \text{ in 2020}$
    - Capital income tax: $\tau_{a,t} \ 35\%$
    - Labor income tax: $\tau_{w,t}$ (determined in eq)
  - Debt $B_{t+1}: \ 156\% \text{ of GDP (in 2015, fixed \%)}$

- Expenditures
  - Public pensions: $p_{i,g,t} = \kappa_t \frac{W_{i,g,t}}{I^{R=1}}$
    - Normal retirement age $I^{R} = 65$ years old
    - Average labor income: $\frac{W_{i,g,t}}{I^{R=1}}$
    - Replacement rate $\kappa_t$: set s.t total benefits are about $10\% \text{ of GDP}$
  - Debt service: $B_t(1 + r_t)$
  - Other government expenditures $G_t: \ 20\% \text{ of GDP}$
Model: the government

\[ G_t + (1 + r_t)B_t + \sum_{i=IR}^{I} \sum_{g} p_{i,g,t}\mu_{i,g,t} = \]
\[ \tau_{w,t}w_t \sum_{i,g} \mu_{i,g,t}\epsilon_{i,g,t} + \tau_{a,t}r_t \sum_{i,g} \mu_{i,g,t}(a_{i,g,t} + b_t) + \tau_{c,t} \sum_{i,g} \mu_{i,g,t}c_{i,g,t} + B_{t+1} \]
Model: firms

- Production

\[ Y_t = Z_t K_t^\alpha N_t^{1-\alpha} \]

- TFP \( Z_t \): growth at 1% in the baseline
- \( K_t = \sum_{i,g} \mu_{i,g,t} (a_{i,g,t} + b_t) - B_t \)
- \( N_t = \sum_{i,g} \mu_{i,g,t} \epsilon_{i,g,t} \)
- \( \alpha = 0.4, \delta = 0.07 \)
Model: Individuals’ problem

\[ V_t(i, g, a_t) = \max_{c_t, a_{t+1}} \{ u(c_t) + \beta s_{i+1, g, t+1} V_{t+1}(i + 1, g, a_{t+1}) \} \]

subject to

\[ (1 + \tau_{c,t})c_t + a_{t+1} = (1 - \tau_{w,t})\epsilon_{i, g, t} w_t + [1 + (1 - \tau_{a,t})r_t](a_t + b_t) + p_{i, g, t} \]

where \( p_{i, g, t} \) denotes pension and is zero for individuals aged below \( I^R \)
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What we do

- **Endogenous**
  - Individuals’ consumption and saving
  - Macro variables \((K, Y, w, r)\)
  - Government tax revenues and expenditures, equilibrium tax

- **Exogenous**
  - Demographics, participation, productivity \(\rightarrow\) determine \(N\)

- **Baseline**
  - Assume the current participation and labor productivity will remain the same
  - Consider alternative scenarios
Baseline model: $K$ and $N$

- Aggregate capital
- Aggregate labor supply

* Normalized by 2015 levels
* Aggregate capital is stationarized by the TFP growth rate.

Female share <30%
Baseline model: $w$ and $r$

Wage

Interest rate

* Wage stationarized by TFP growth and normalized by 2015 level.
Baseline model: Equilibrium tax rate on labor

Equilibrium tax rate on labor
• Females differ from males in:
  • Participation rates
  • Employment types (regular, contingent, self-employed)
  • Productivity
    → Assume a gradual increase / convergence towards males

• The elderly
Senarios

- Participation rates
  - Use 2018 projections of the Japan Institute for Labor Policy and Training (JILPT) up to 2040
Labor force participation: data and projection

* LFS (2015) data and JILPT projections (2025, 2040)
Labor force participation: data and projection

* LFS data (2002 and 2015) and JILPT projections (2025 and 2040)
Female labor supply: employment types

* LFS data (2002 and 2015)
Female labor supply: decomposition

* LFS data (2002 and 2015)
### Scenarios: Female labor supply

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFP-1</td>
<td>Rise in participation: JILPT projections</td>
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<td>LFP-2</td>
<td>LFP-1 + gradual convergence of employment types to males</td>
</tr>
<tr>
<td>LFP-3</td>
<td>LFP-2 + gradual convergence of productivity to males</td>
</tr>
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</table>
Scenarios: Female labor supply

- A main factor of rise of aggregate labor supply is not only a rise in labor force participation, but also changes in employment type and productivity.
- Although savings initially decline to smooth consumption, aggregate capital will eventually be higher than in the baseline.
Scenarios: Female labor supply

- More participation by female will significantly reduce the fiscal burden.
- Impact from lower wage < higher labor supply
## Scenarios: Female labor supply

(relative to the baseline of the same year)

<table>
<thead>
<tr>
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<th>LFP-1 Participation</th>
<th>LFP-2 Emp. type</th>
<th>LFP-3 Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agg. labor supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>+5.6%</td>
<td>+12.1%</td>
<td>+22.4%</td>
</tr>
<tr>
<td>2045</td>
<td>+7.8%</td>
<td>+18.8%</td>
<td>+37.3%</td>
</tr>
<tr>
<td>Agg. output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>+3.3%</td>
<td>+6.9%</td>
<td>+11.8%</td>
</tr>
<tr>
<td>2045</td>
<td>+6.7%</td>
<td>+16.1%</td>
<td>+31.1%</td>
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**Scenarios: Female labor supply**

(relative to the baseline of the same year)

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<tr>
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<th>LFP-2 +Emp. type</th>
<th>LFP-3 +Productivity</th>
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<tbody>
<tr>
<td>Wage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>−2.2%</td>
<td>−4.7%</td>
<td>−8.6%</td>
</tr>
<tr>
<td>2045</td>
<td>−1.0%</td>
<td>−2.3%</td>
<td>−4.8%</td>
</tr>
<tr>
<td>2060</td>
<td>+0.3%</td>
<td>+0.9%</td>
<td>+0.9%</td>
</tr>
<tr>
<td>Eq. tax rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td>−1.1ppt</td>
<td>−2.3ppt</td>
<td>−4.0ppt</td>
</tr>
<tr>
<td>2045</td>
<td>−1.5ppt</td>
<td>−3.4ppt</td>
<td>−5.8ppt</td>
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# Scenarios: the elderly and males

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<td>LFP-2 + gradual convergence of productivity to males</td>
</tr>
<tr>
<td>LFP-4</td>
<td>Same as LFP-1 but only 65 and below</td>
</tr>
<tr>
<td>LFP-5</td>
<td>Same as LFP-1 but both males and females</td>
</tr>
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</table>
Scenarios: the elderly and males

LFP-1: female: all  
LFP-4: female: only aged <65  
LFP-5: male and female: all ages

1 vs 4: effects of elderly female  
1 vs 5: effects of males
## Scenarios: the elderly and males

(relative to the baseline of the same year)

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<th>LFP-4</th>
<th>LFP-5</th>
</tr>
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<tr>
<td></td>
<td>Female: all ages</td>
<td>Female age &lt;65</td>
<td>Male and female</td>
</tr>
<tr>
<td></td>
<td>2030</td>
<td>+5.6%</td>
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1 – 4 difference is limited. Most elderly female work on a contingent job at very low wages.
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Conclusion

- Females and the elderly can indeed be savers

- But: we need more than a simple increase in participation. A rise in labor supply through changes in employment types and productivity is a key

  - Output in 2045:
    - +6.7% (participation ↑ only)
    - +16.1% (+ employment type)
    - +31.1% (+ productivity)

  - Eq. tax rate in 2045:
    - −1.5 ppt (participation ↑ only)
    - −3.4 ppt (+ employment type)
    - −5.8 ppt (+ productivity)
Remarks: next step

- Explain participation (and hours) and wage to study policy implications.
  - Blundell, et al (2019): Use panel of the UK to quantify effects of job training on female labor supply (especially post-births of children)