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

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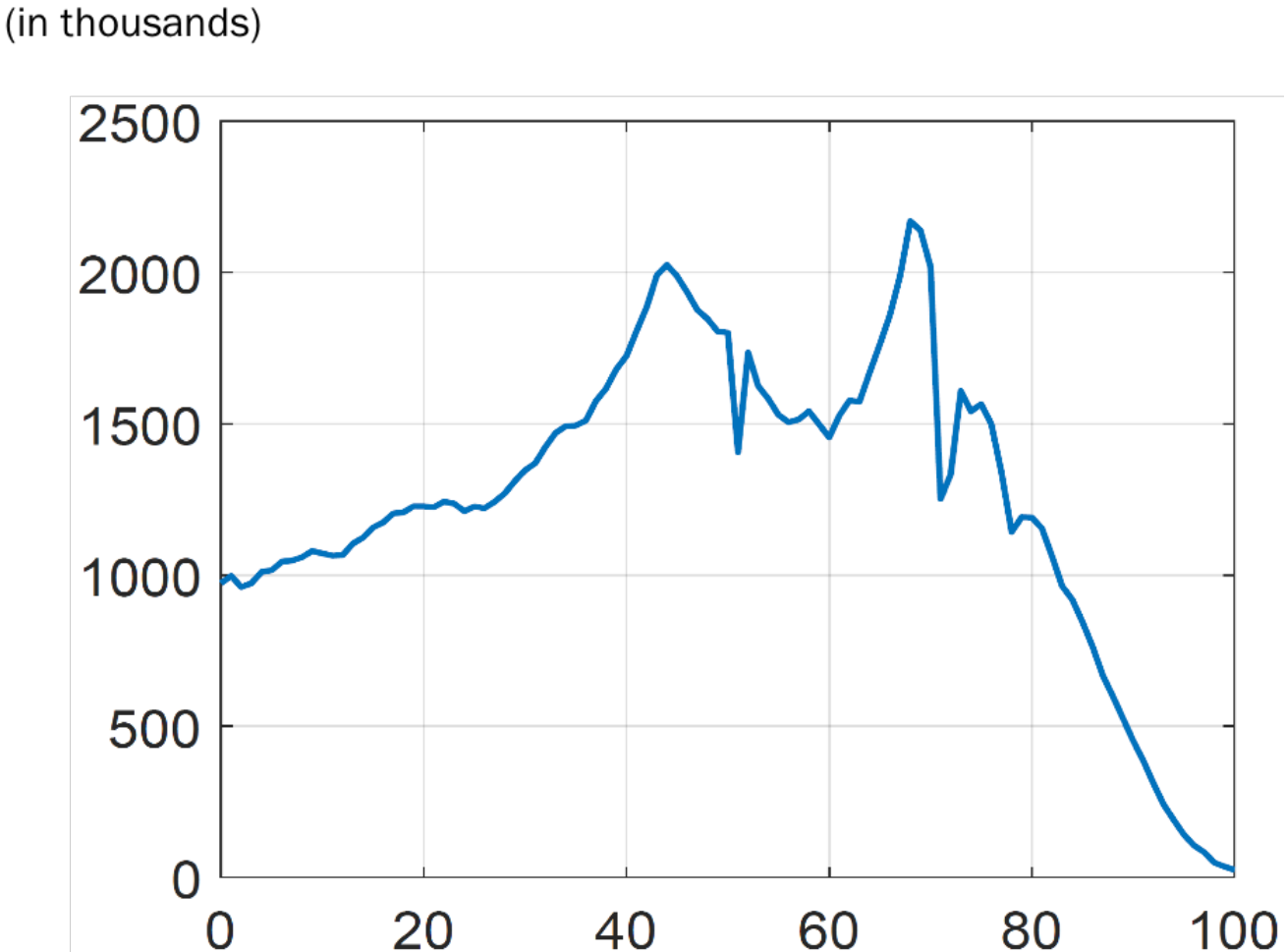
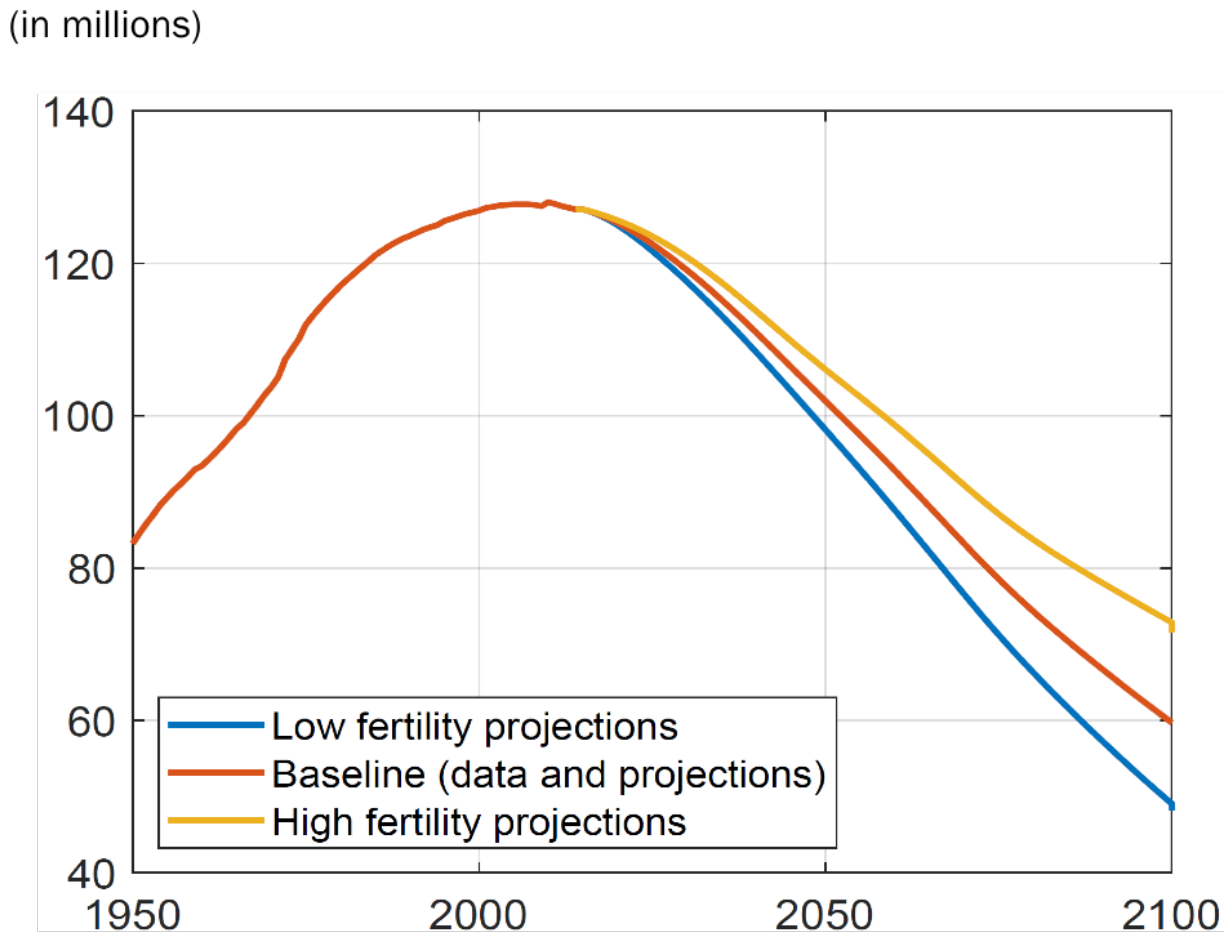
Age distribution in Japan (2017)



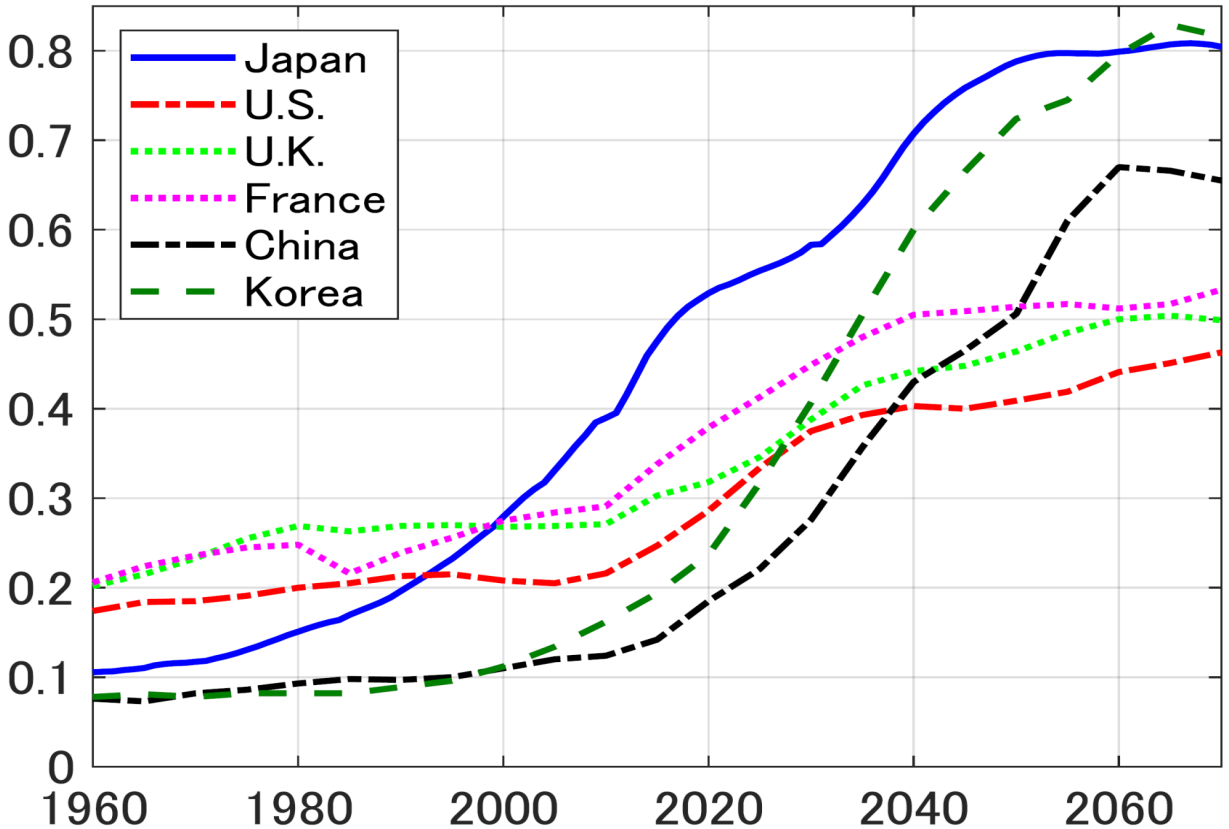
Source: IPSS (2017)

Population (data and projections)



Source: IPSS (2017)

Old-age dependency ratio (age 65 up/20-64)



Source: IPSS (2017) and United Nations (2015)

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 ?

$\rightarrow$ Japanese government is keen on encouraging labor force participation of females and the elderly.

$\leftrightarrow$ 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

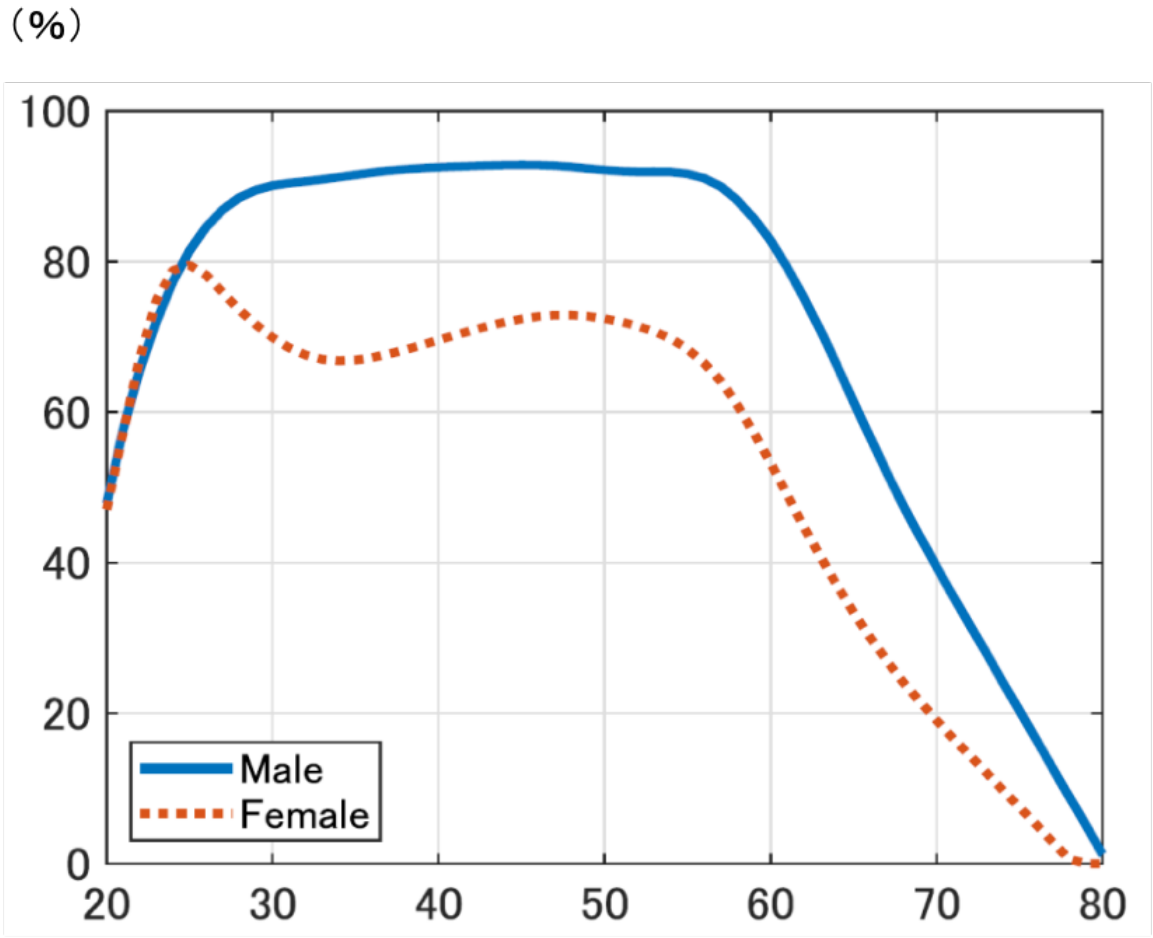
- Braun and Joines (2015), Kitao (2015), Hansen and Imrohoroglu (2016)
  - A life-cycle model with endogenous labor supply

  $\rightarrow$ But, abstracts from differences in gender, employment types and productivity difference gap.

- Hoshi and Ito (2014), Imrohoroglu, Kitao and Yamada (2018)
  - Generational accounting models

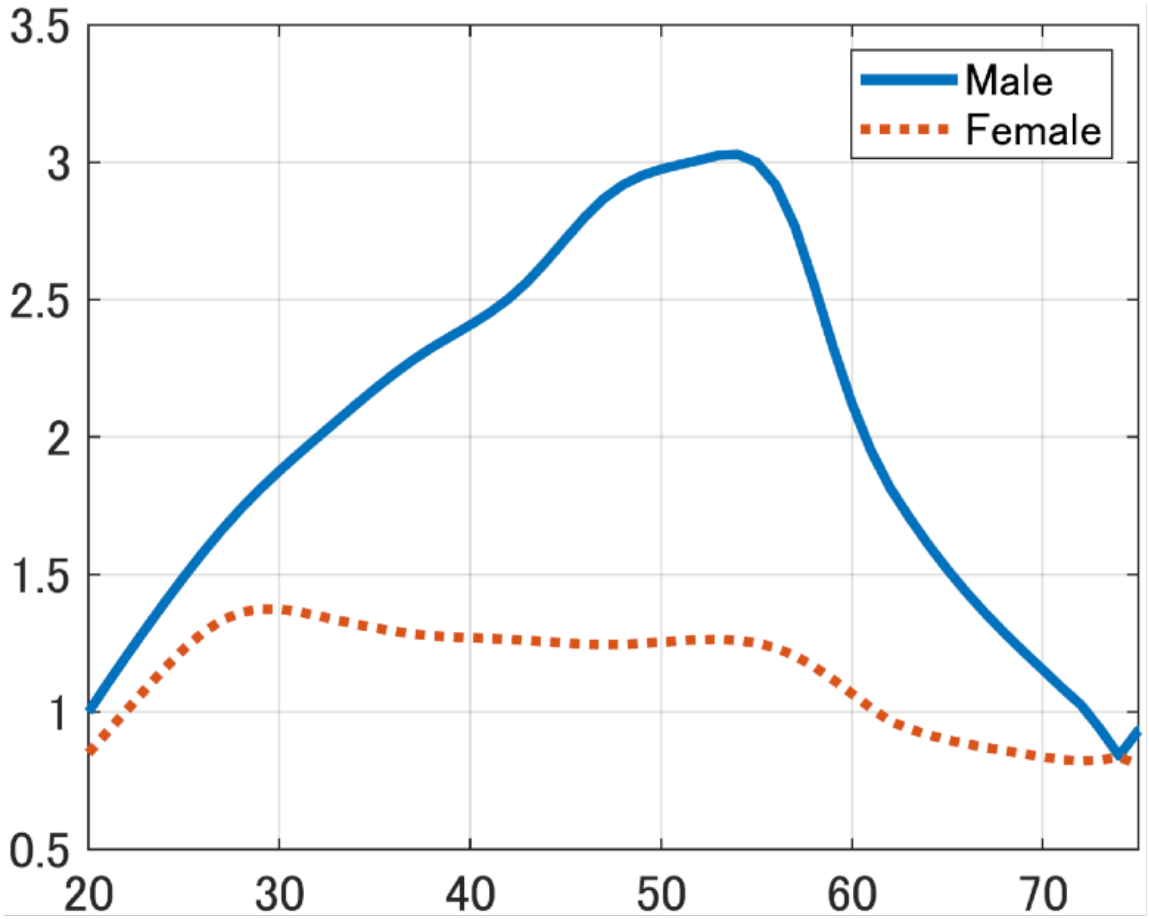
  $\rightarrow$ PE and exogenous policy.

Labor force participation rates



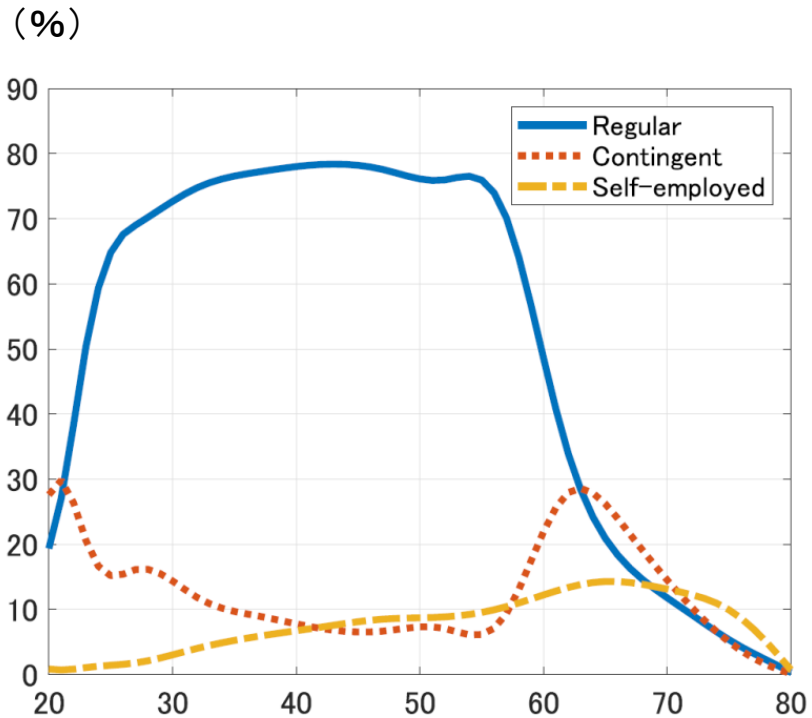
Source: Labor Force Survey (2015)

Earnings (workers)

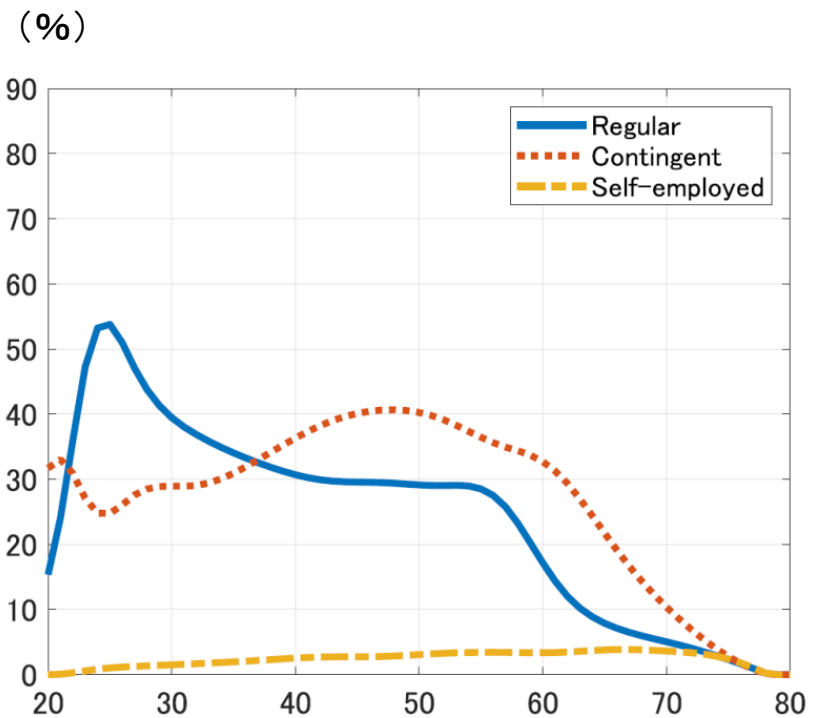


Source: Basic Survey on Wage Structure (2015), normalized by age-20 male earnings

Participation rates by employment types



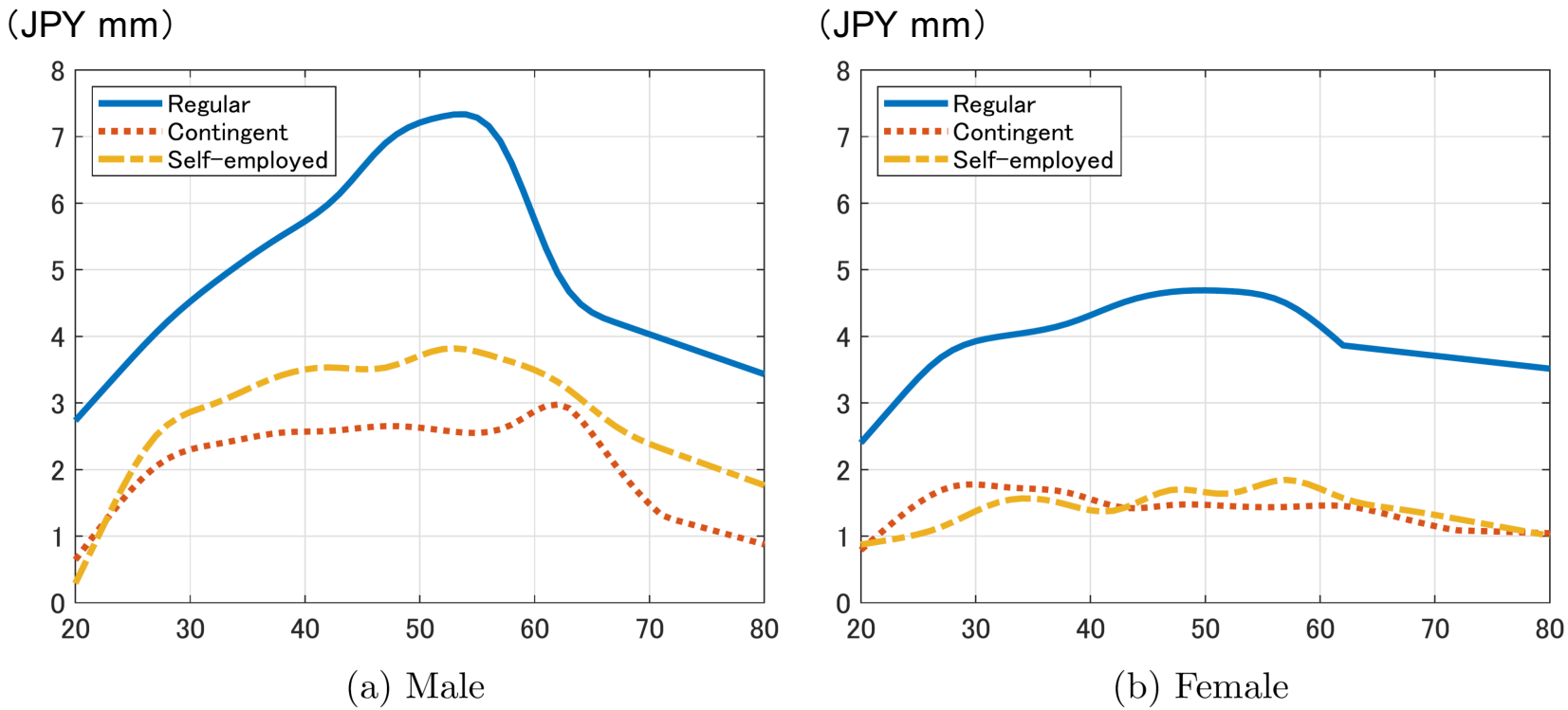
(a) Male



(b) Female

Source: LFS (2015)

Earnings by gender and employment type



(a) Male (b) Female

Source: BSWS (2015) and ESS (2015)

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 : Indivudual

- 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 : β set s.t $K/Y = 3.2$ (average during 2010-2014)

Model : labor market

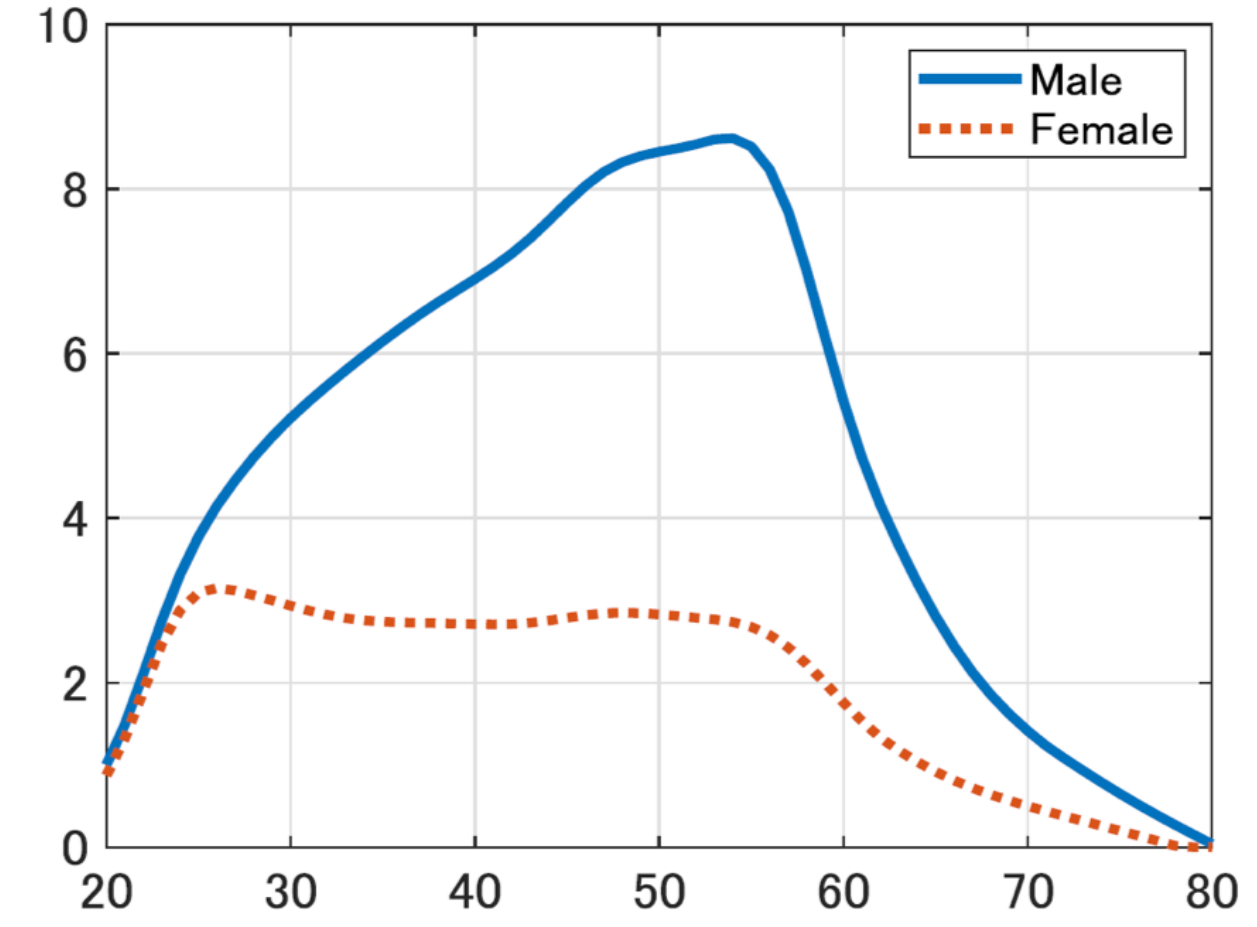
- Earnings of age i, year t, gender g : $\epsilon_{i,g,t} \times w_t$
- $\epsilon_{i,g,t}$: average labor productivity
  - Average efficiency units provided by an individual of age i, in year t, gender g
  - Computed based on data of participation rates, employment type and productivity
- w_t : Market 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 $y^R_{i,g,t}, y^C_{i,g,t}, y^S_{i,g,t}$

$$\epsilon_{i,g,t} = (y^R_{i,g,t}\mu^R_{i,g,t} + y^C_{i,g,t}\mu^C_{i,g,t} + y^S_{i,g,t}\mu^S_{i,g,t})/\mu_{i,g,t}$$

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 % in 2020
    - Capital income tax : $\tau_{a,t}$ 35%
    - Labor income tax : $\tau_{w,t}$ (determined in eq)
  - Debt B_{t+1} : 156 % 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 κ_t : set s.t total benefits are about 10 % of GDP
  - Debt service : $B_t(1 + r_t)$
  - Other government expenditures G_t : 20 % of GDP

Model : the government

$$G_t + (1 + r_t)B_t + \sum_{i=I^R}^{I} \sum_{g} p_{i,g,t}\mu_{i,g,t} =$$

$$\tau_{w,t}w_t \sum_{i,g} \mu_{i,g,t}\epsilon_{i,g,t} + \tau_{a,t}r_t \sum_{i,g} \mu_{i,g,t}(a_{i,g,t} + b_t) + \tau_{c,t} \sum_{i,g} \mu_{i,g,t}c_{i,g,t} + B_{t+1}$$

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 : Indivuduals' 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

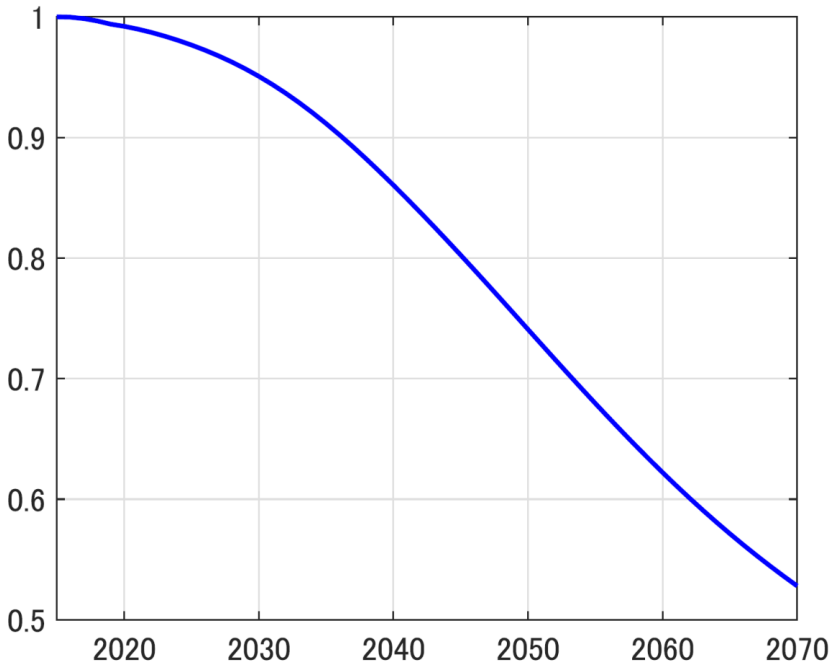
$$(1 + \tau_{c,t})c_t + a_{t+1} = (1 - \tau_{w,t})\epsilon_{i,g,t} w_t + [1 + (1 - \tau_{a,t})r_t](a_t + b_t) + p_{i,g,t}$$

where $p_{i,g,t}$ denotes pension and is zero for individuals aged below I^R

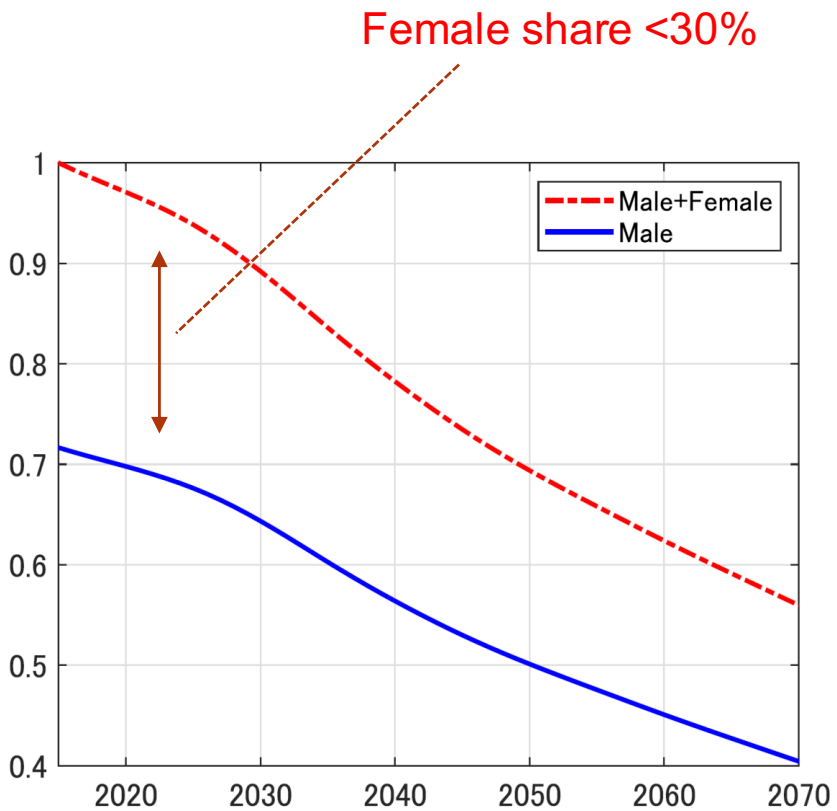
What we do

- 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



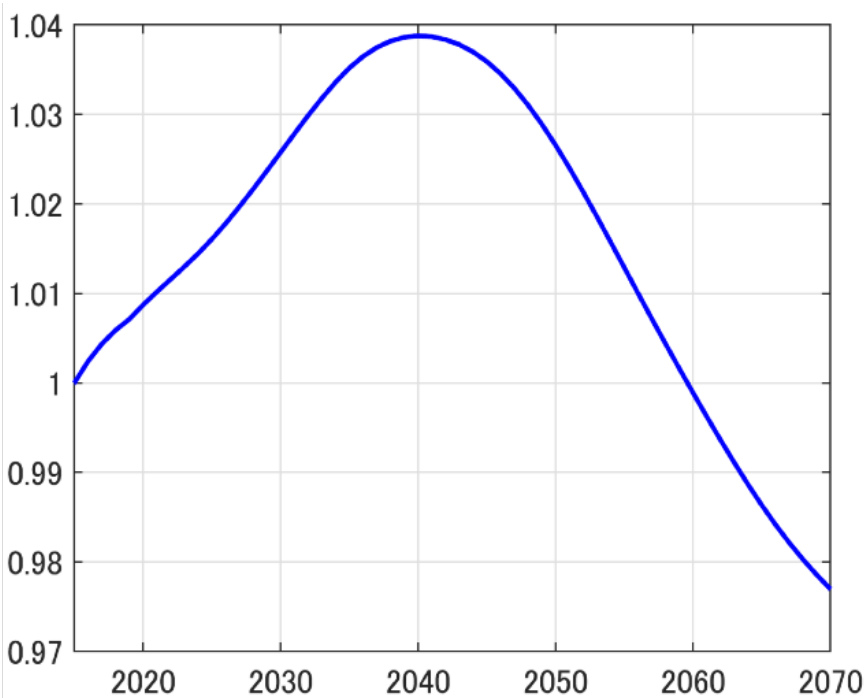
Aggregate capital



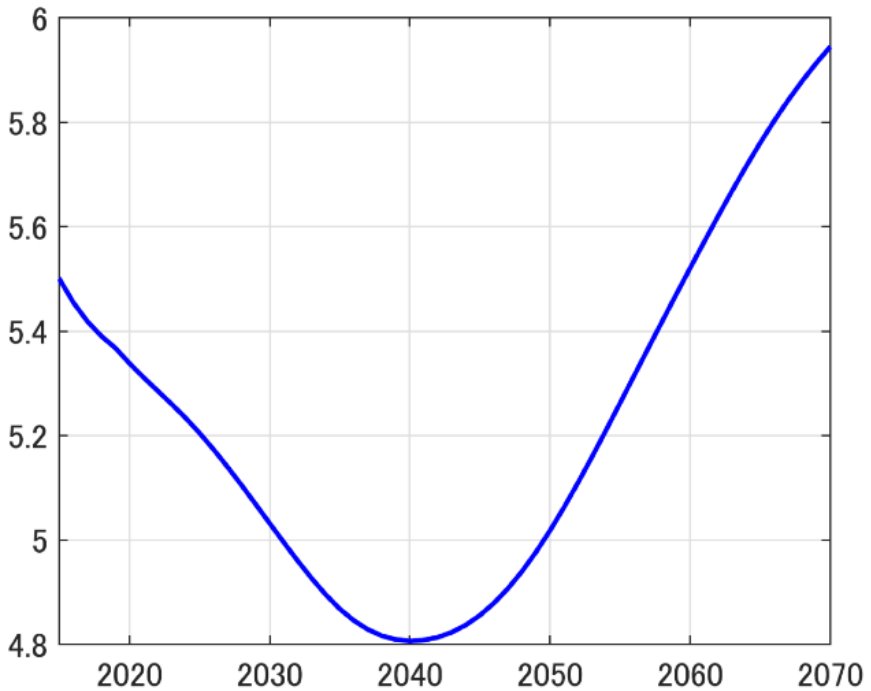
Aggregate labor supply

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

Baseline model : w and r



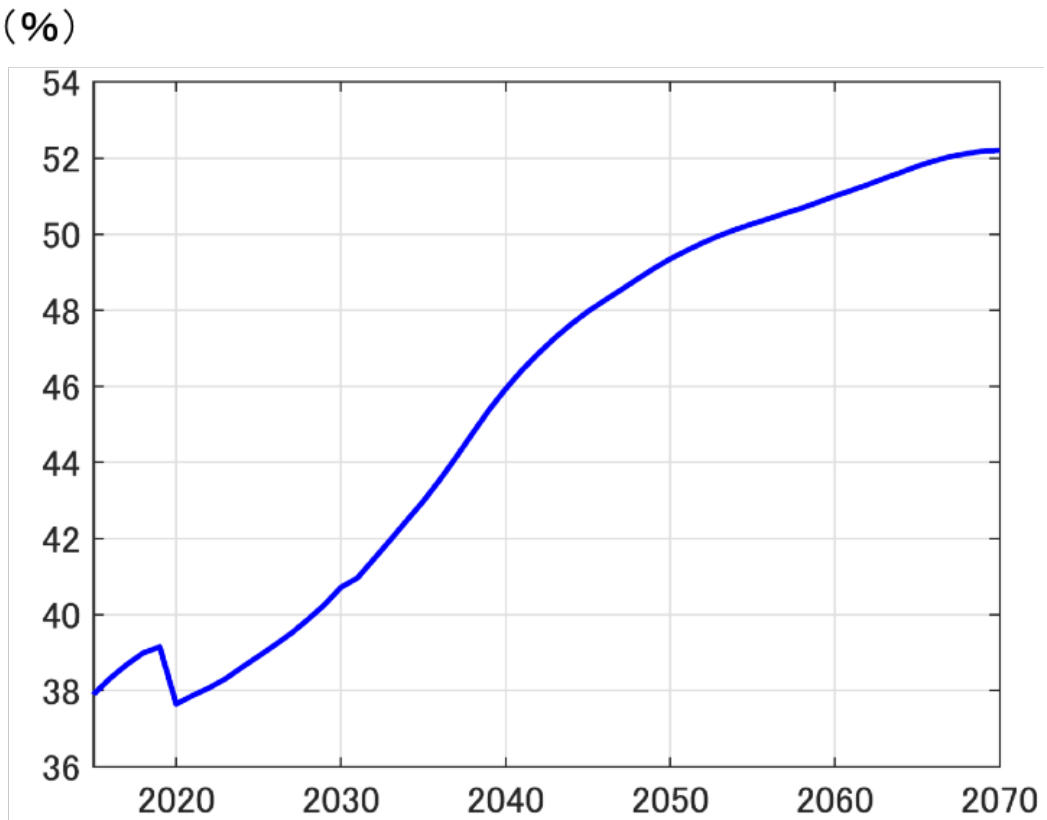
Wage



Interest rate

∗ Wage stationarized by TFP growth and normalized by 2015 level.

Baseline model : Equilibrium tax rate on labor



Equilibrium tax rate on labor

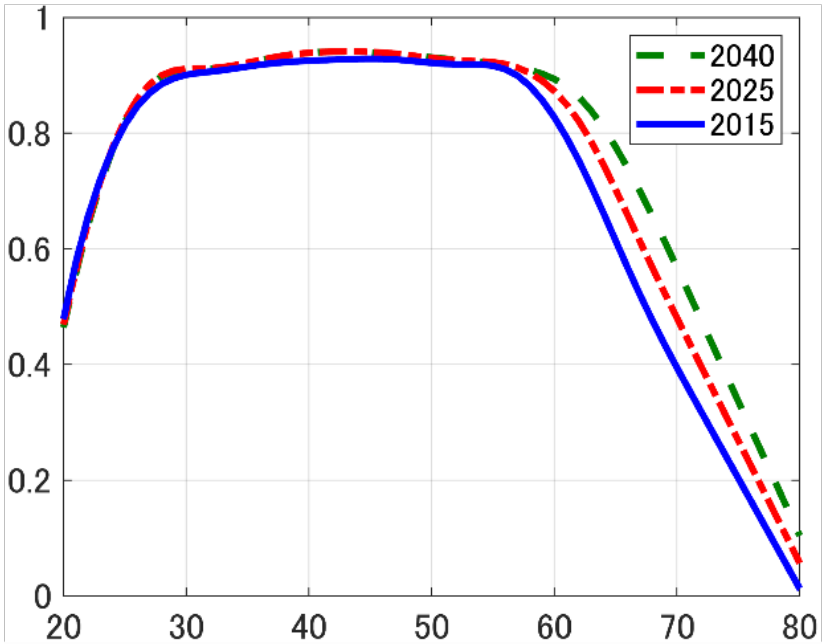
Senarios

- Females differ from males in :
  - Participation rates
  - Employment types (regular, contingent, self-employed)
  - Productivity
    $\rightarrow$ Assume a gradual increase / convergence towards males
- The elderly

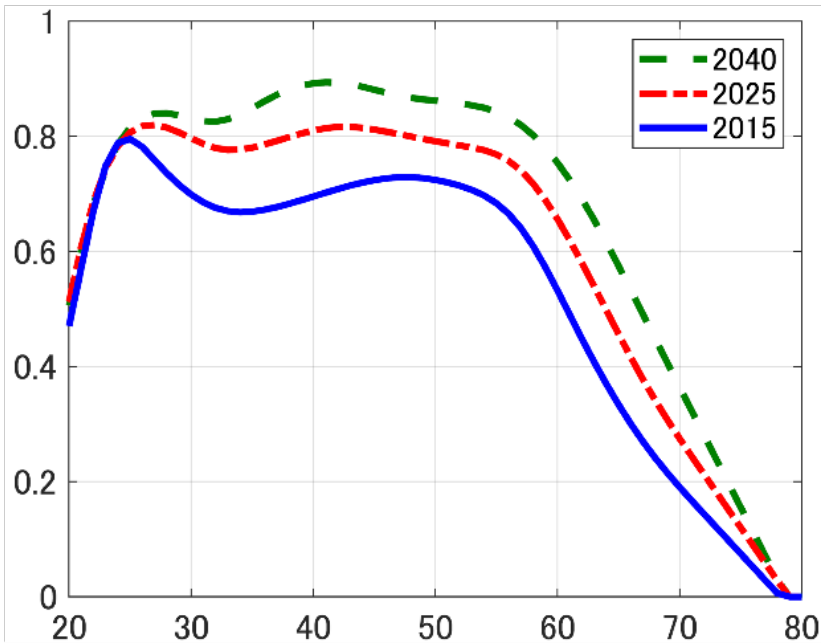
Senarios

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

Labor force participation : data and projection



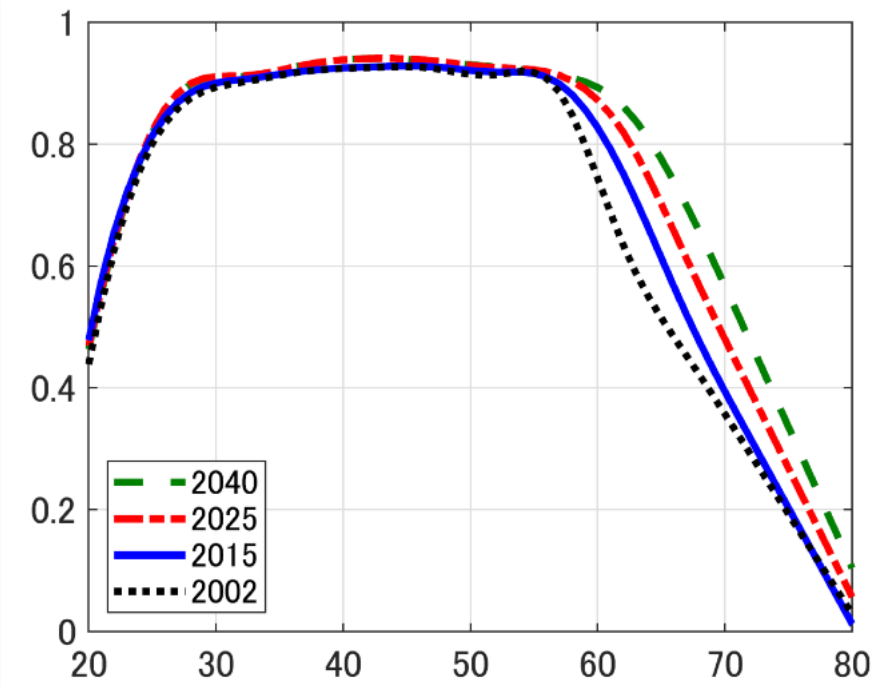
Male



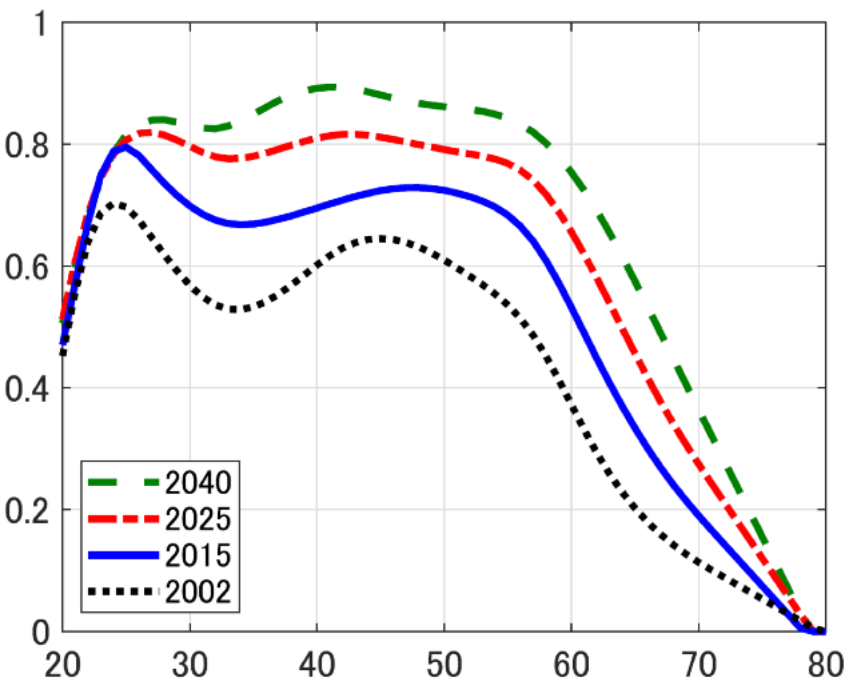
Female

* LFS (2015) data and JILPT projections (2025,2040)

Labor force participation : data and projection



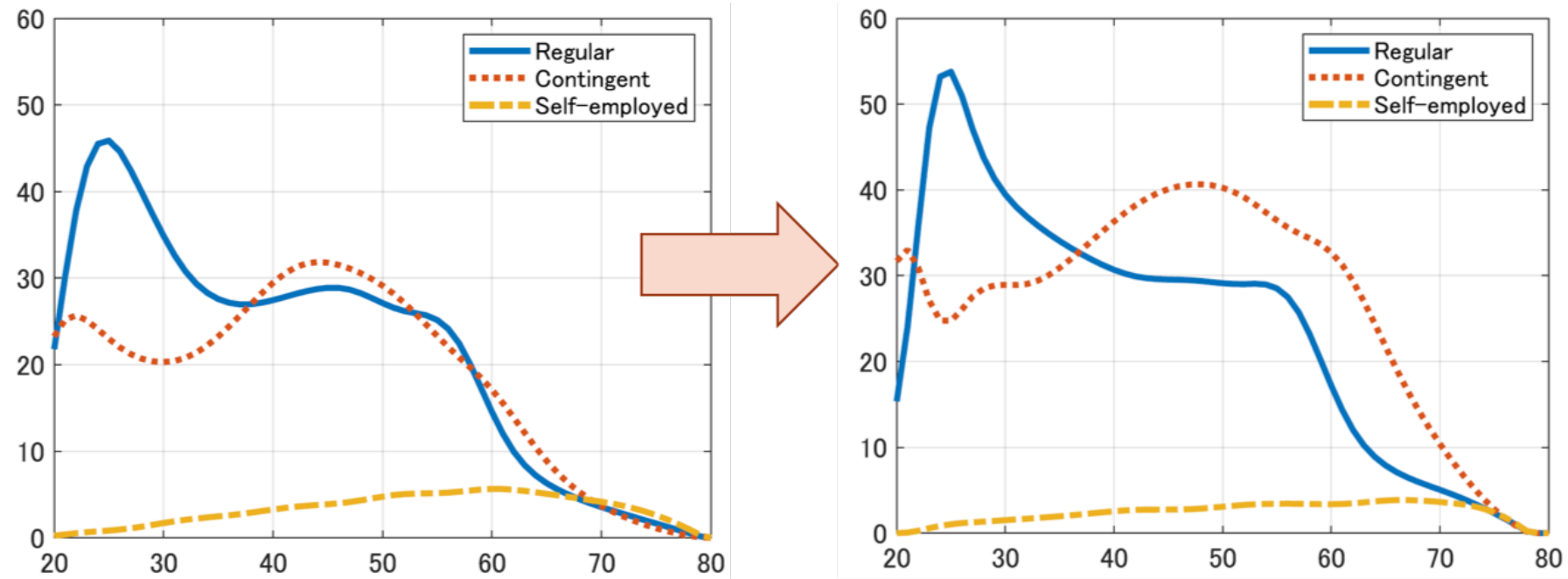
Male



Female

* LFS data (2002 and 2015) and JILPT projections (2025 and 2040)

Female labor supply: employment types

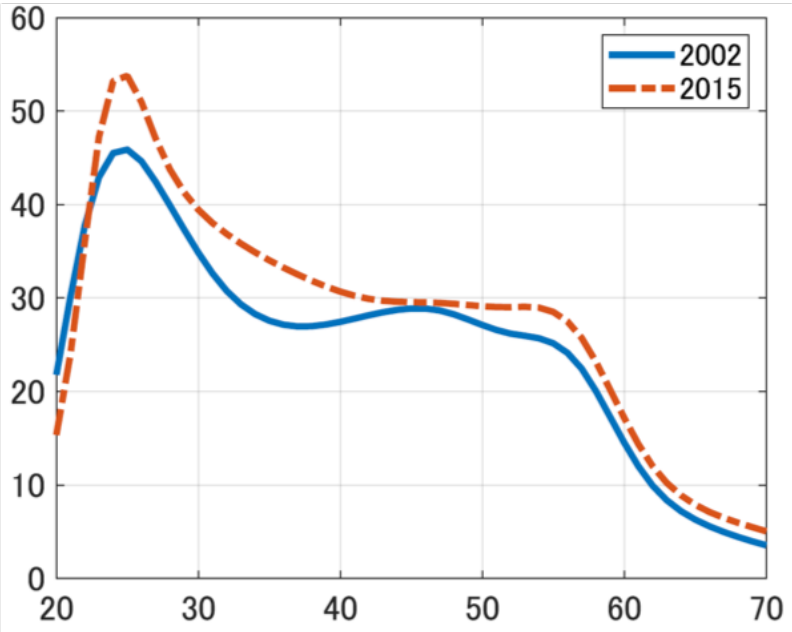


2002

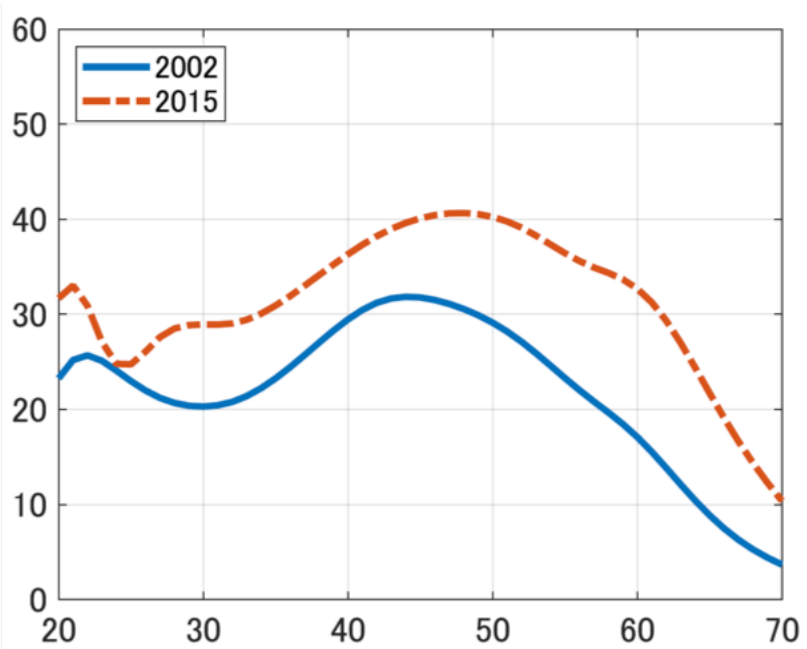
2015

* LFS data (2002 and 2015)

Female labor supply: decomposition



Regular



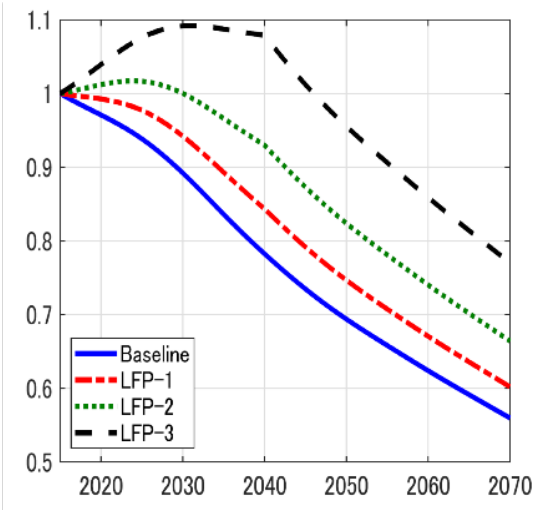
Contingent

* LFS data (2002 and 2015)

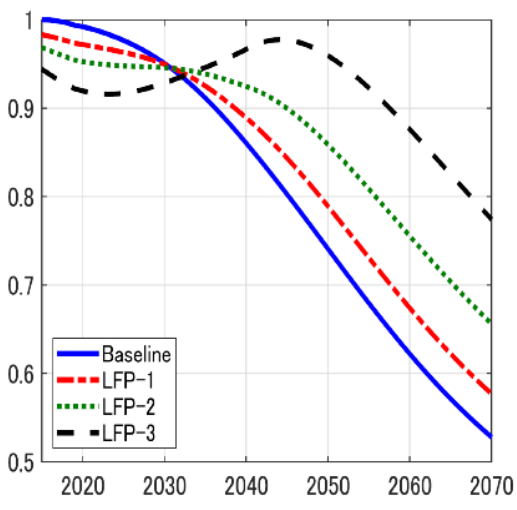
Scenarios : Female labor supply

Scenario	
LFP-1	Rise in participation : JILPT projections
LFP-2	LFP-1 + gradual convergence of employment types to males
LFP-3	LFP-2 + gradual convergence of productivity to males

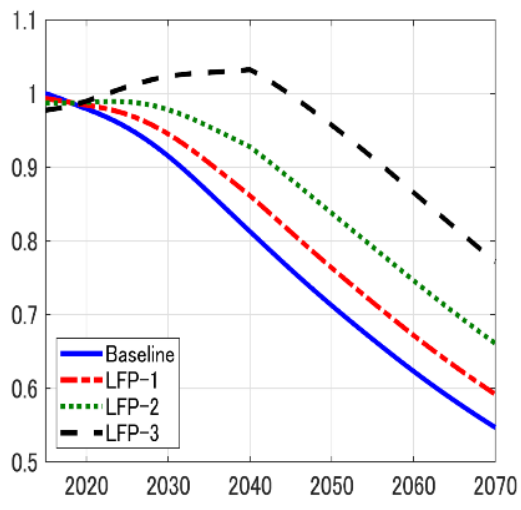
Scenarios : Female labor supply



Aggregate labor supply



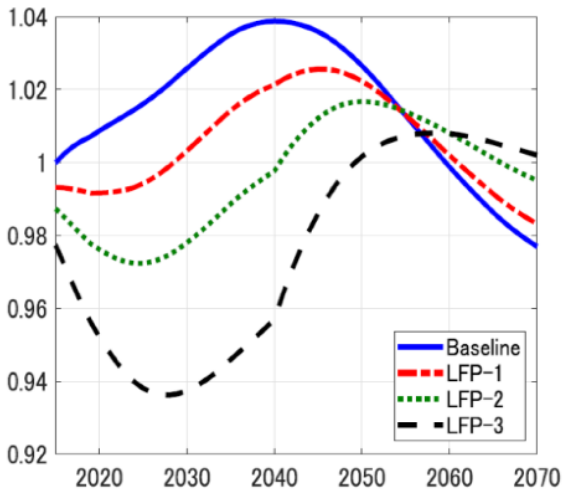
Aggregate capital



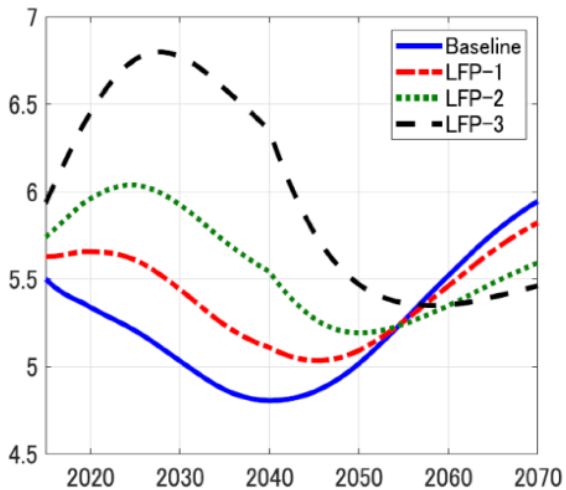
Aggregate output

- 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.

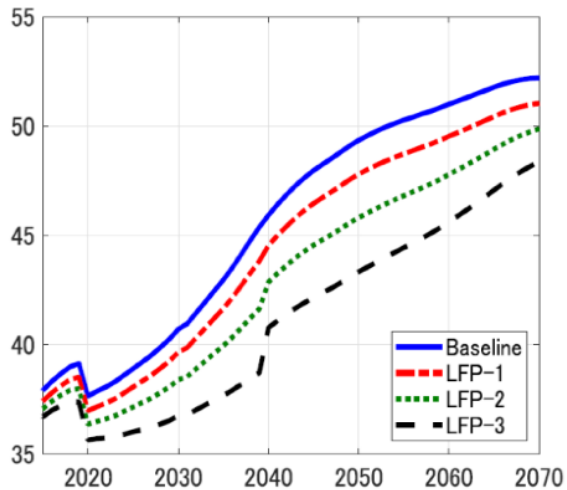
Scenarios : Female labor supply



(a) Wage



(b) Interest rate (%)



(c) Tax rate (%)

- More participation by female will significally reduce the fiscal burden.
- Impact from lower wage $<$ higher labor supply

Scenarios : Female labor supply

(relative to the baseline of the same year)

	LFP-1 Participation	LFP-2 +Emp. type	LFP-3 +Productivity
Agg. labor supply			
2030	+5.6%	+12.1%	+22.4%
2045	+7.8%	+18.8%	+37.3%
Agg. output			
2030	+3.3%	+6.9%	+11.8%
2045	+6.7%	+16.1%	+31.1%

Scenarios : Female labor supply

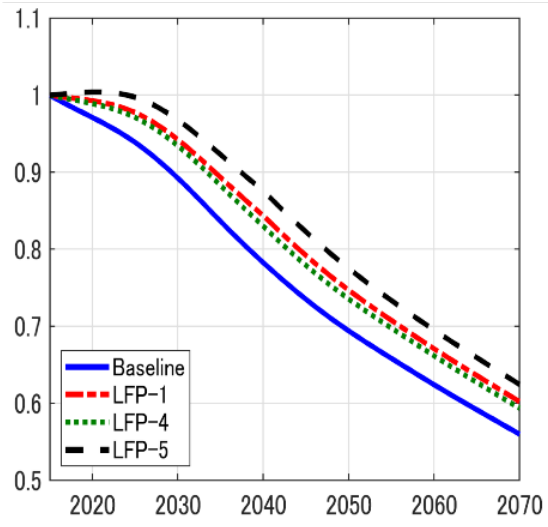
(relative to the baseline of the same year)

	LFP-1 Participation	LFP-2 +Emp. type	LFP-3 +Productivity
Wage			
2030	−2.2%	−4.7%	−8.6%
2045	−1.0%	−2.3%	−4.8%
2060	+0.3%	+ 0.9%	+0.9%
Eq. tax rate			
2030	−1.1ppt	−2.3ppt	−4.0ppt
2045	−1.5ppt	−3.4ppt	−5.8ppt

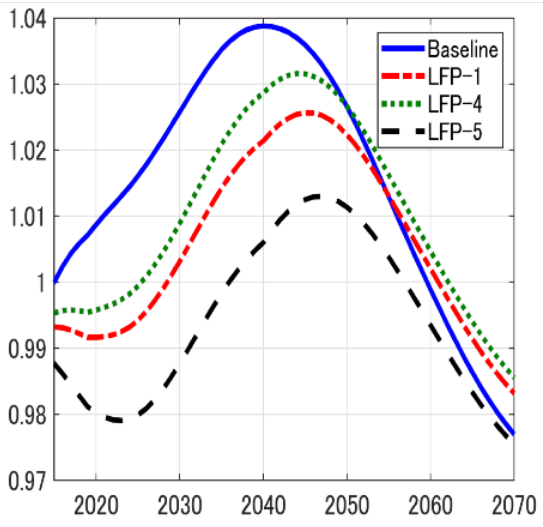
Scenarios : the elderly and males

Scenario	
LFP-1	Rise in participation : JILPT projections
LFP-2	LFP-1 + gradual convergence of employment types to males
LFP-3	LFP-2 + gradual convergence of productivity to males
LFP-4	Same as LFP-1 but only 65 and below
LFP-5	Same as LFP-1 but both males and females

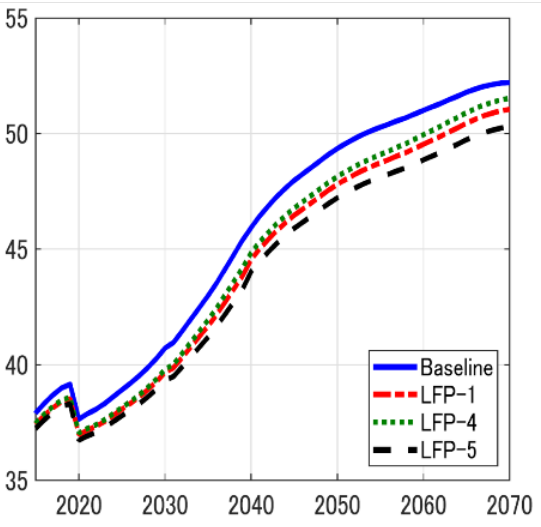
Scenarios : the elderly and males



Labor supply



Wage



Eq. tax rate

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)

	LFP-1 Female: all ages	LFP-4 Female age <65	LFP-5 Male and female All aAges
Agg. labor supply			
2030	+5.6%	+4.7%	+8.5%
2045	+7.8%	+6.0%	+11.9%
Agg. output			
2030	+3.3%	+3.0%	+4.4%
2045	+6.7%	+5.5%	+9.4%
Eq. tax rate			
2030	−1.1ppt	−0.9ppt	−1.4ppt
2045	−1.5ppt	−1.2ppt	−2.1ppt

$1-4$ difference is limited. Most elderly female work on a contingent job at very low wages.

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 $\uparrow$ only)
    - $+16.1\%$ ($+$ employment type)
    - $+31.1\%$ ($+$ productivity)
  - Eq. tax rate in 2045 :
    - -1.5 ppt (participation $\uparrow$ only)
    - -3.4 ppt ($+$ employment type)
    - -5.8 ppt ($+$ productivity)

Remarks : next step

- Explain participation (and hours) and wage to study policy implications.
    - Attanasio, et al (2008), Bundell, et al (2016)
    - Blundell, et al (2019) : Use panel of the UK to quantify effects of job training on female labor supply (especially post-births of children)