Demographic Aging, Fiscal Reforms and Macroeconomy in Japan*

An Overview

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*The views expressed are those of authors and do not necessarily reflect those of the ESRI.

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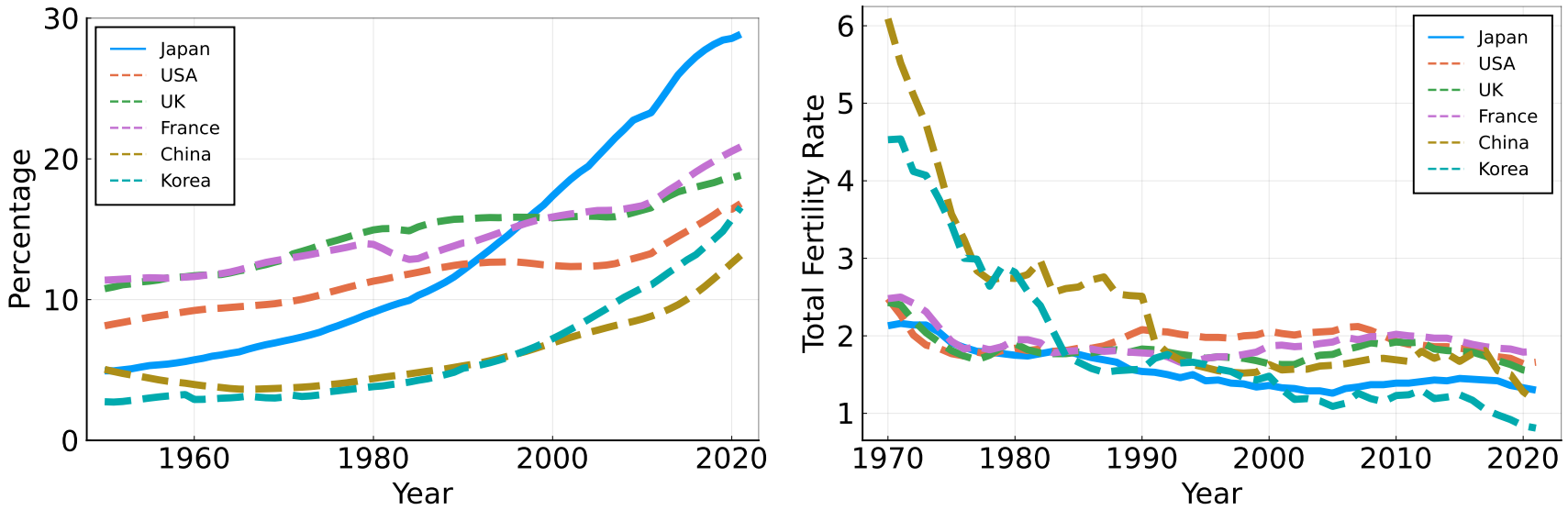
I. Introduction

Introduction

- Japan is one of the lowest birthrate and the fastest aging population
  - Korea & China: currently total fertility rate lower than Japan
- Population has already peaked out in 2008
- This presentation: **population aging $\Leftrightarrow$ macroeconomy & public debt**
  - I will present a menu of potentially important policies
  - Not sustainability: sustainable by assumption

Population Aging in the World



Source: OECD. Left: percentage of elderly (65+). Right: total fertility rate. While the aging of society is progressing worldwide, it is especially true in Japan. The total fertility rate (TFR) is well below the population replacement level of 2.06, and the TFR is expected to remain low and population aging continues.

Why Important?: Macroeconomic View

Population aging will put preasures on reforms of:

1. Public pension system
2. Health insurance system
3. long-term care system: elderly care
   - 1:3 $\Rightarrow$ **Public debt accumulation**

Population aging also has the macroeconomic impacts:

4. Shortage of labor supply
   - Female workers $\Leftarrow$ marriage, child care etc.
   - Elderly workers: 65+
   - Foreign workers/guest workers
   - Education (productivity)/AI
5. Capital accumulation (savings)
   - 4:5 $\Rightarrow$ **Economic growth and factor prices**

This Presentation

- This presentation will organize policy proposals that could improve the current situation and discuss potentially effective policies
- Overview of the liturature:
  - A large number of papers have already been written with Japanese data/calibrated parameters
  - Still, there may be a shortage
- Focus on overlapping generations (OLG) models $\Rightarrow$ most variables here are exogenous except macroeconomic variables
  - Not explain why/how: what happen if...
  - Importance of general equilibrium effects and budget constraint of the governement

Literature Review: OLG Models (Incomplete List)

OLG Models excluding Researches on Japanese Economy

- Canonical overlapping generations (life cycle) model
  - Samuelson (1958), Diamond (1965), Auerbach and Kotlikoff (1987)
- Social security reforms and public debt:
  - De Nardi, et al. (1999), Nishiyama and Smetters (2005,2007), Kotlikoff et al. (2007), Peterman and Sager (2022)
- Health insurance and nursing care insurance:
  - Attanasio et al. (2011), Conesa et al. (2018), Braun et al. (2017,2019)
- Labor supply:
  - Nishiyama (2019)
- Savings and capital assumulation:
  - Scholz et al. (2006), Attanasio et al. (2007), Braun et al. (2017), Auclert et al. (2021)
- Immigration:
  - Storesletten (2000,2003), Busch et al. (2019)

Literature Review: Public Debt (Incomplete List)

Research on Japanese Economy: Not OLG Model

- Sustainability of Japanese government bonds (JGBs)
  - U.S.: Bohn (1998), Blanchard (2019,2023)
  - **Japan:** Broda and Weinstein (2005), Doi (2006), Oshio and Oguro (2013), Hoshi and Ito (2014), Yoshino et al. (2015), Eguchi and Hatano (2022)
- Generation accounting:
  - Auerbach, Kotlikoff and Leibfritz (1999), Yoshida (2005), Kitaura (2016)
- Macro simulation on social security reform:
  - Fukawa and Sato (2009)

II. Model

A Benchmark Model: Overview

A benchmark OLG model:

1. Households maximize their utility over life cycle
2. Firms maximize their profits
3. Population aging
4. Dynamic general equilibrium:
   - market clearing: goods, labor and capital markets
   - government budget balance incl. social security system
   - (steady state and) transition
5. Calibrate model parameters to match Japanese economy

Demogarphics

- t: calender time
- $j \in \{0, ..., js, ..., jr, ..., J\}$: age
  - $j \leq js - 1$: childhood (no economic activity)
  - $js \leq j \leq jr$: working age
  - $jr + 1 \leq j \leq J$: retired
  - jr: mandatory retirement age
- Population dynamics:
  - $\zeta_{j,t}$: survival probability from age j to $j + 1$
  - $\mu_{j,t}$: cohort size
  - the cohort size $\mu_{j,t}$ evolve as

$$\mu_{j+1,t+1} = \zeta_{j,t}\mu_{j,t}$$

Households' Problem

Instantaneous utility function:

$$u(c_{j,t+j-1}) = \frac{c_{j,t+j-1}^{1-\gamma}}{1-\gamma}$$

- $c_{j,t}$: consumption of age j at time t
- γ: relative risk aversion

Households' Problem (cont.)

After-tax labor income:

$$y_{j,t} = (1 - \tau_t^y)\tilde{y}_{j,t}$$

- $\tilde{y}_{j,t} = w_t \eta_j$: before-tax labor income
  - w_t: macroeconomic wage level ($=1$ in the benchmark year)
  - η_j: age specific productivity
    - deterministic
    - $= 0$ after retirement
- τ_t^y: sum of
  1. labor income tax τ_t^l
  2. payroll tax for public pension τ_t^{ss}
  3. universal health insurance premium τ_t^{uhi}
  4. long-term care insurance premium τ_t^{lnc}

Households' Problem (cont.)

Budget constraint of individual:

$$(1+\tau_t^c)c_{j,t} + a_{j+1,,t+1} = y_{j,t} + ss(\hat{y}) + R_t(a_{j,t} + b_t) - m_j - \xi^*$$

- τ_t^c: consumption tax at period t
- $ss_t(\hat{y})$: pension benefit (> 0 if $j > jr$)
  - $\hat{y}$: past average earnings that determines the earnings-related part of the public pension (*kosei nenkin*) $\Rightarrow$ next slide
- $a_{j,t}$: a composite of capital and government bonds
- b_t: accidental bequest
  - lump-sum transfer by the government
- R_t: after-tax gross return
- m_j: mandatory medical and long-term care expenditures
- ξ^*: lump-sum tax

Households' Problem (cont.)

Public pension system:

- **Two-tier structure** of public pension system based on Japanese system

$$ss(\hat{y}) = \rho_0 + \rho_1 \hat{y}$$

  - ρ_0: basic pension (*kokumin nenkin* in Japanese)
  - ρ_1: coefficient for earnings-related part (*kosei nenkin* in Japanese)
  - $\hat{y}$: record of past earnings (*hosyu hirei* part)
- Transition of the record of the past earnings
  - $\hat{y}_{j+1} = \frac{j\hat{y}_j + \min(\tilde{y}_{j,t}, y^{\max})}{j+1}$ if $j \leq jr$
  - $\hat{y}_{j+1} = \hat{y}_j$ if $j > jr$

Households' Problem (cont.)

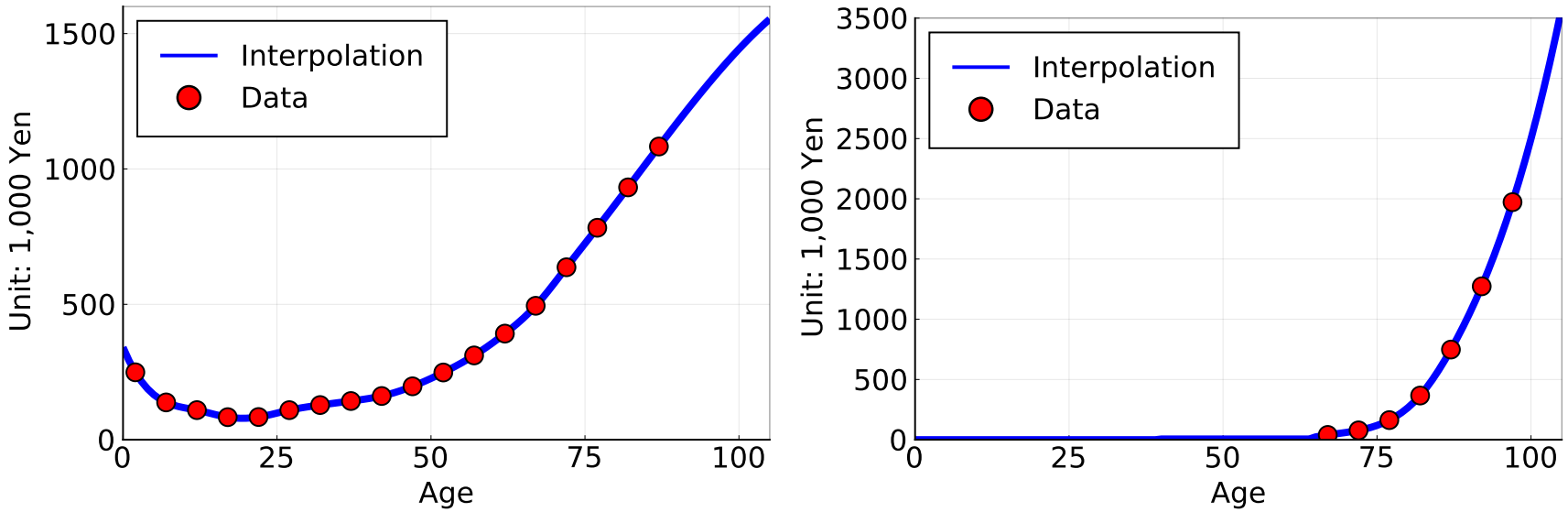
Medical expenditure:

- m_j: **out-of-pocket** expenditure from medical treatment and long-term nusring care
- Out-of-pocket expenditures consist of medical expenditure and long-term care expenditure:

$$m_j = \lambda_j^h m_j^h + \lambda^l m_j^l$$

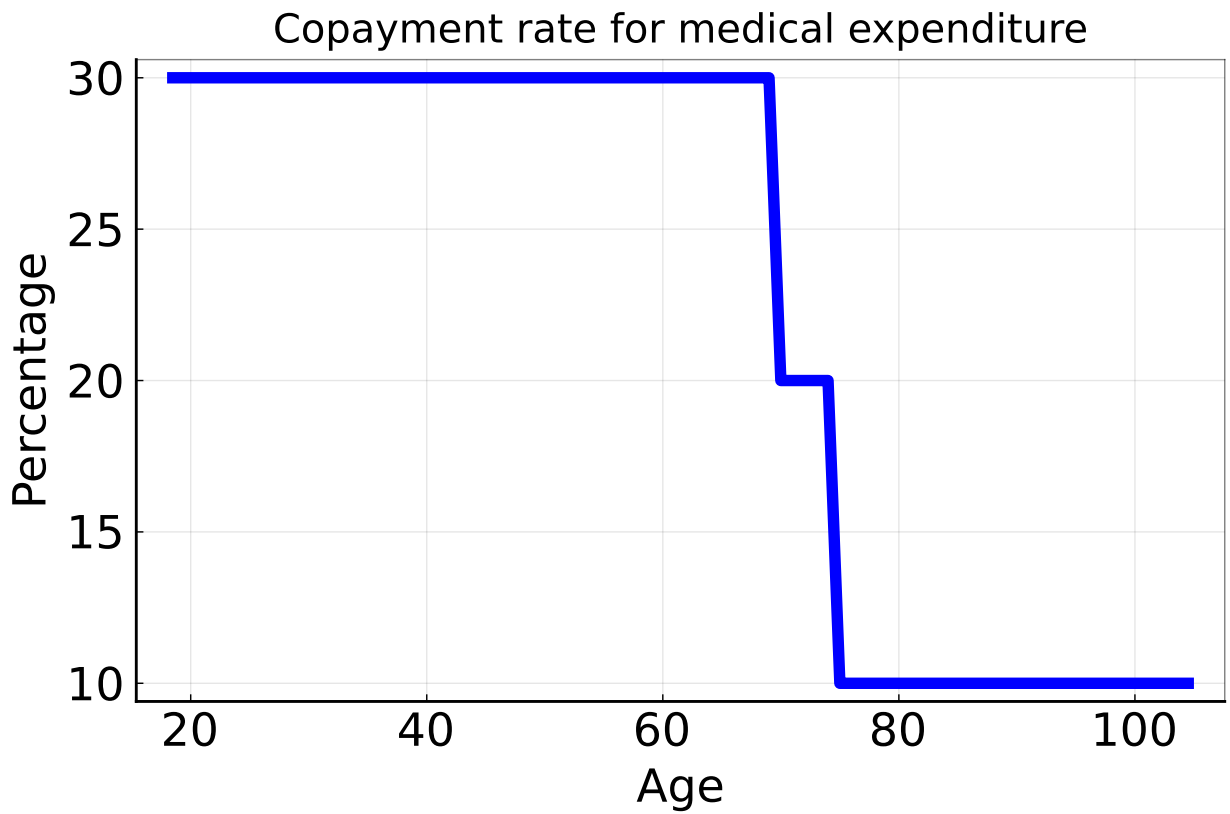
  - m_j^h: medical expenditure by age
  - m_j^l: long-term care expenditure by age
  - λ_j^h: copay for medical expenditure: age dependent
  - λ_j^l: copay for nursing care expenditure

Medical Expenditure: Calibration



Source: Author's calculation from the Estimates of National Medical Care Expenditure and the Statistics of Long-term Care Benefit Expenditures. Left: average expenditure on medical treatment by age. Right: average expenditures on long-term care by aging.

Copayment Rate by Age: 2019



Copayment rates differ by age: 30% before 69, 20% between 70 and 74, 10% after 75. Children under age 6 pay 20%, but the model does not count children directly.

Households' Problem (cont.)

Savings on capital and government bond:

- Two types of assets: capital and government bond
  - different interest rates: r_t^k and r^d
  - r_t^k: endogenous in the model, r^d: exogenous
- How to determine capital and government bond holdings
  - introduce share parameter ϕ: exogenous
  - $a_{j,t} = (1-\phi) \times CAPITAL + \phi \times DEBT$
    - Braun et al. (2015) assume time variant share parameter
- After-tax gross return on individuals' savings

$$R_t = 1 + (1-\tau_t^k) r_t^k (1-\phi) + (1-\tau_t^d) r^d \phi$$

  - ϕ: bond holdings, $1-\phi$: capital holdings
  - τ_t^k: capital income tax
  - τ_t^d: tax on return from government bond

Technology

Production function:

- Cobb-Douglas production function

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha}$$

  - Z_t: total factor productivity (exogenous)

- Aggregate capital

$$K_t = \sum_j \mu_{j,t} a_{j,t}$$

- Aggregate labor

$$L_t = \sum_j \mu_{j,t} \eta_j$$

Government Budget

Government's budget constraint:

$$G_t + (1 + r^d) D_{t-1} + S_t + M_t = T_t^y + T_t^a + T_t^c + D_t + \xi^*$$

- Revenue:
  - T_t^y: labor income tax
  - T_t^a: capital income tax
  - T_t^c: consumption tax (endogenous)
  - D_t: newly issued government bond
  - ξ^*: lump-sum tax/transfer
- Expenditure:
  - G_t: government expenditure (exogenous)
  - D_{t-1}: government bond issued in the last year
  - S_t: public pension expenditures
  - M_t: medical expenditure + long-term care expenditure

Competitive Equilibrium

The competitive equilibrium consists of:

1. Households' optimization
2. Firms' optimization
3. Government budget balance: unified
   - public pension
   - health insurance
   - long-term care insurance
4. Goods market, capital market, and labor market clearing

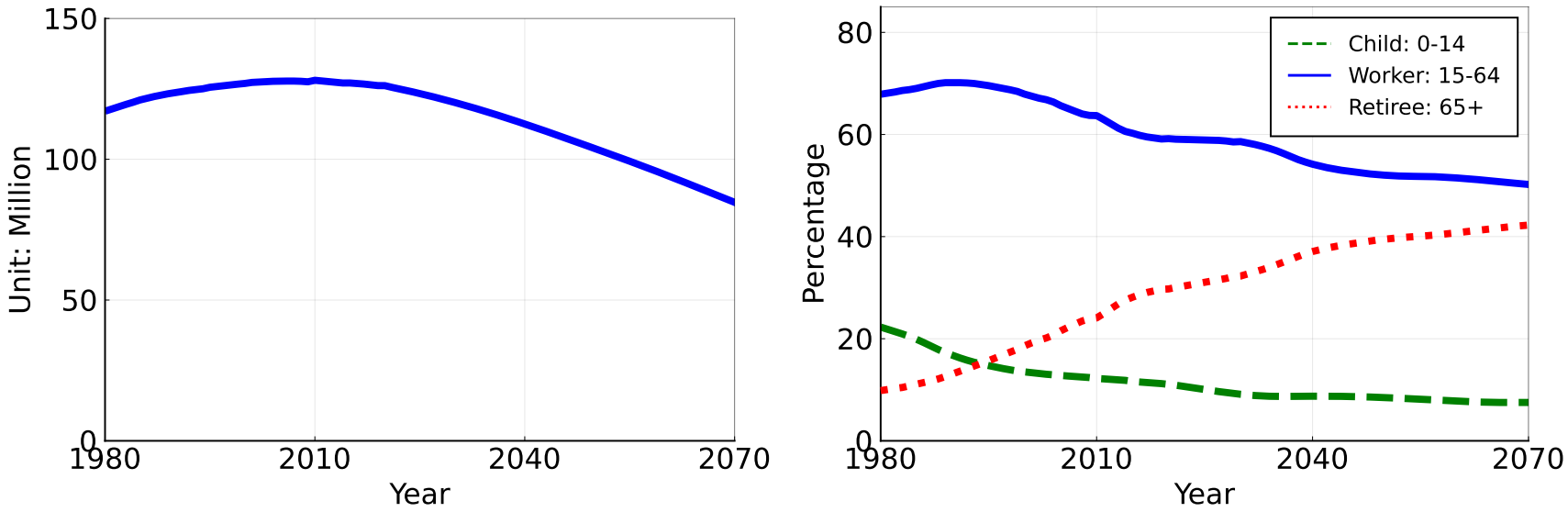
III. Calibration

Demographics

Population distribution

- National Institute of Population and Social Security Research (IPSR)
  - projection from 2020 to 2070
  - Three variants for fertility and mortality rates

Population Projection



Source: "Population Projections for Japan" released in 2023 by IPSS. Left: the dynamics of total population. Right: fraction of each age group.

Other Calibrated Parameters

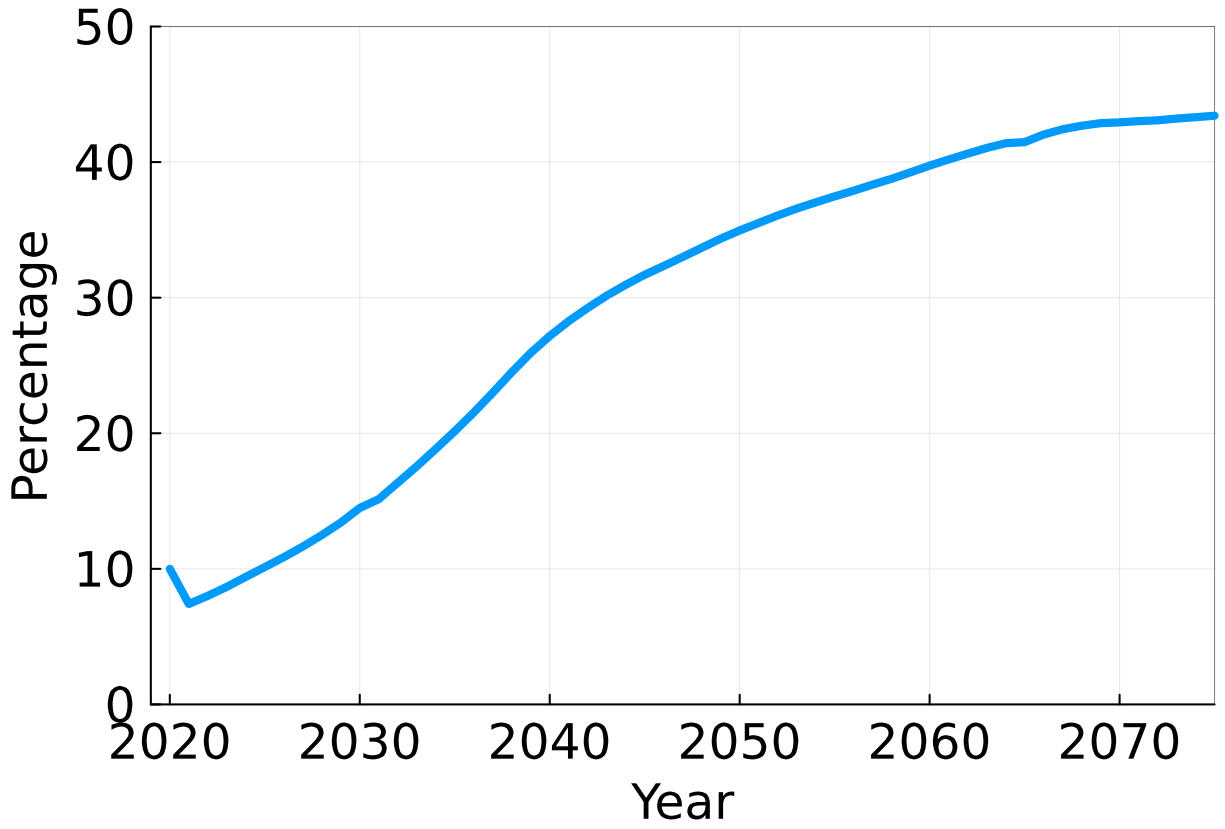
Parameter	Description	Values
Preferences		
β	subjective discount factor	1.028 ($K/Y = 2.5$)
γ	risk aversion	2.0
Labor market		
$\{\eta_j\}_{j=20}^{jr}$	labor income	BSWS
Technology		
g	TFP growth rate	1.0%
α	capital share	0.3783
δ	capital depreciation rate	0.0842

Other Calibrated Parameters (cont.)

Parameter	Description	Values
Government		
τ^l	labor income tax	7%
τ^{ss}	payroll tax	18.3%
τ^c	consumption tax	10%
τ^k	capital income tax	35%
τ^d	tax on gov. bond return	20%
D/Y	net debt to GDP ratio in 2019	1.5625
r^d	int. on government bond	1.0%

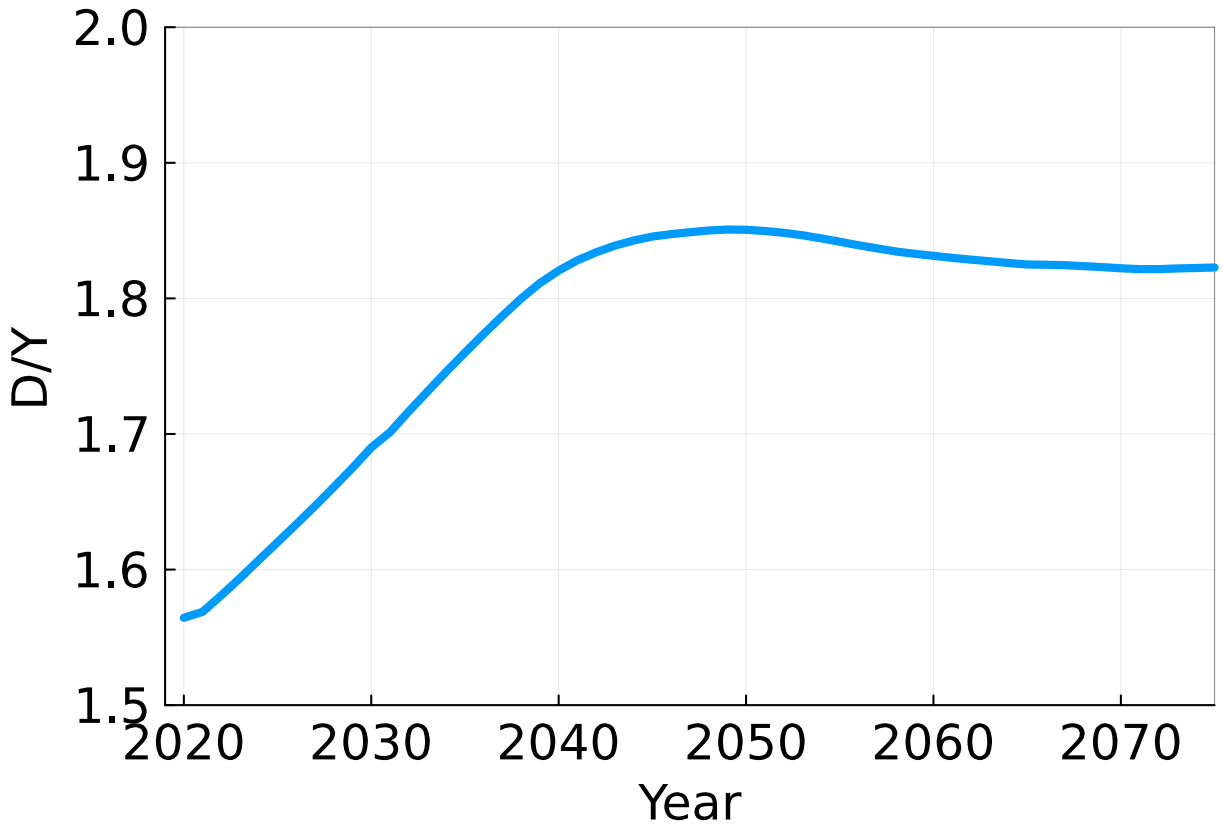
IV. Results and Discussion

Consumption Tax Rate



This figure plots the consumption tax rate needed to balance the government's budget constraint. In equilibrium, the consumption tax rate will exceed 40% around 2060.

Debt to GDP Ratio

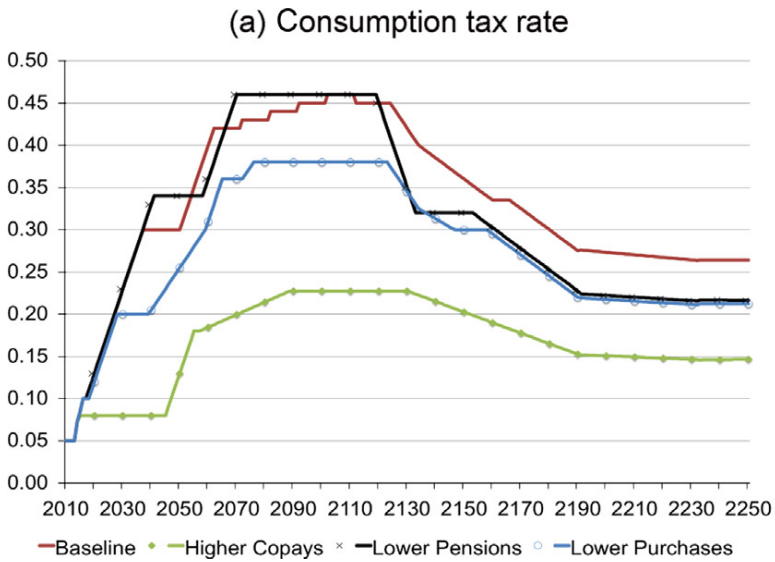


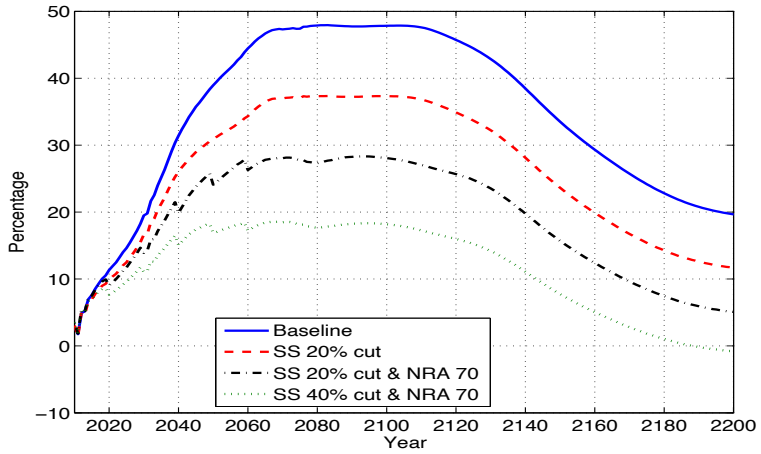
The model assumes that individual savings are allocated exogenously to capital accumulation and government bond holdings at a rate of ϕ and $1-\phi$. If this ratio remains unchanged, the government debt ratio is projected to increase by about 25%. Note that the COVID-19 shock is not included in this simulation.

Comparison

- Previous studies have also used the consumption tax rate to calculate future burdens
- **NOTE:** NOT arguing that the entire amount of public debt should be covered by the consumption tax
  - just for measurement purpose
- Other research:
  - Braun and Joines (2015): 46% in 2070
  - Kitao (2015a): 48% in 2070
- Why differences? $\Rightarrow$ model specification and calibrated parameters

Comparison in the Literature





Left: Braun and Joines (2015), Figure 6 (a). Right: Kitao (2015a), Figure 9.

Social Insurance Reforms

1. Public pension reforms
   - lower pension & higher copay: Braun and Joines (2015)
   - removing earnings-related part: Okamoto (2013)
   - individual retirement accounting: Kitao (2015b)
2. Health insurance reforms
   - Hsu and Yamada (2019), Fukai et al. (2022)
3. long-term care reforms
   - Mikoshiba (2023)

$\Rightarrow$ **No single policy reform can have a major impact on fiscal sustainability**: İmrohoroğlu et al. (2016)

$\Rightarrow$ Fiscal reforms *improve* welfare of future generations

Public Pension Reforms: D/Y

Accounting approach: Imrohoroglu et al. (2016)

- Note: different model and different calibration parameters
  - Consumption tax rate: **fixed**
  - Govt budget constraint no longer satisfied ⇒ D/Y diverge

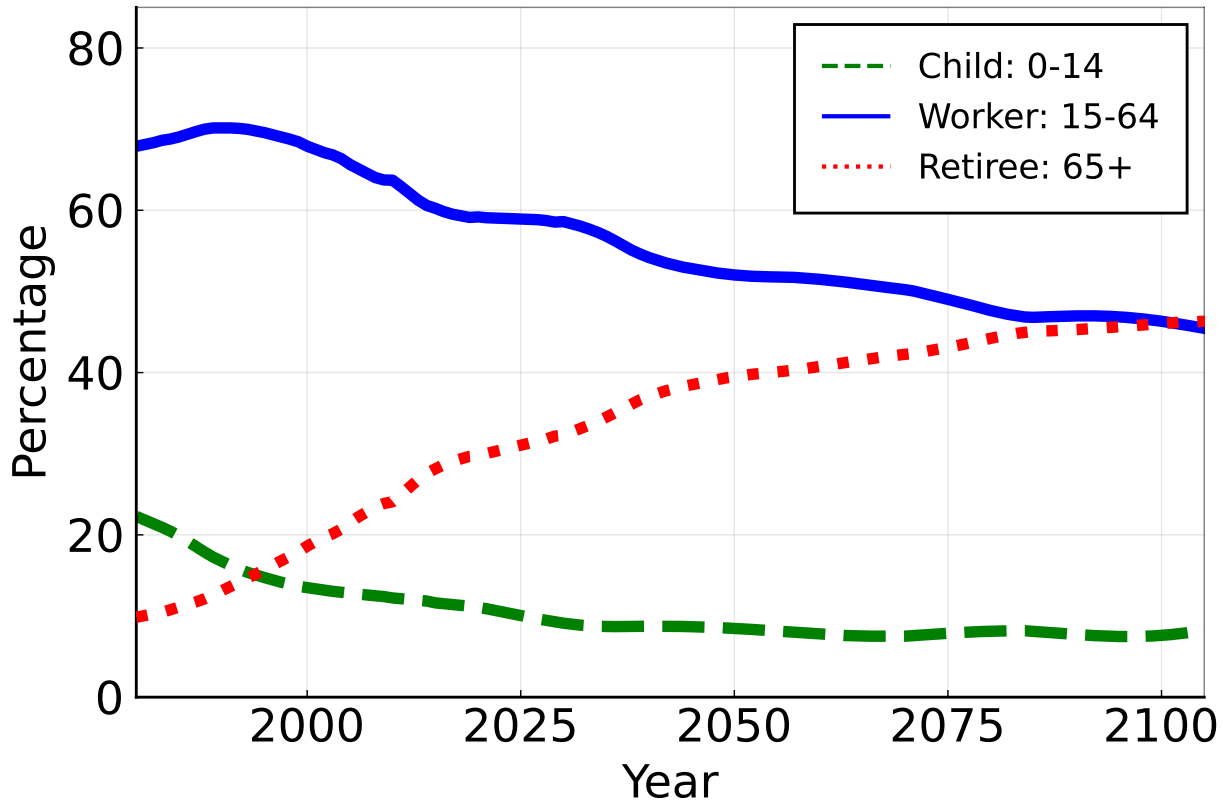
	Baseline	$jr = 70$	Benefit cut by 10%	$jr = 70$ and Benefit cut by 10%	Earnings tax rate up by 5%
2020	1.640	1.624	1.518	1.504	1.637
2040	2.632	2.381	2.223	1.998	2.286
2060	4.411	3.577	3.553	2.803	3.497

- Raising the retirement age to 70, or benefit cut by 10%, reduces the debt to GDP by 80% in 2060, still insufficient for fiscal sustainability

Macroeconomic Implications

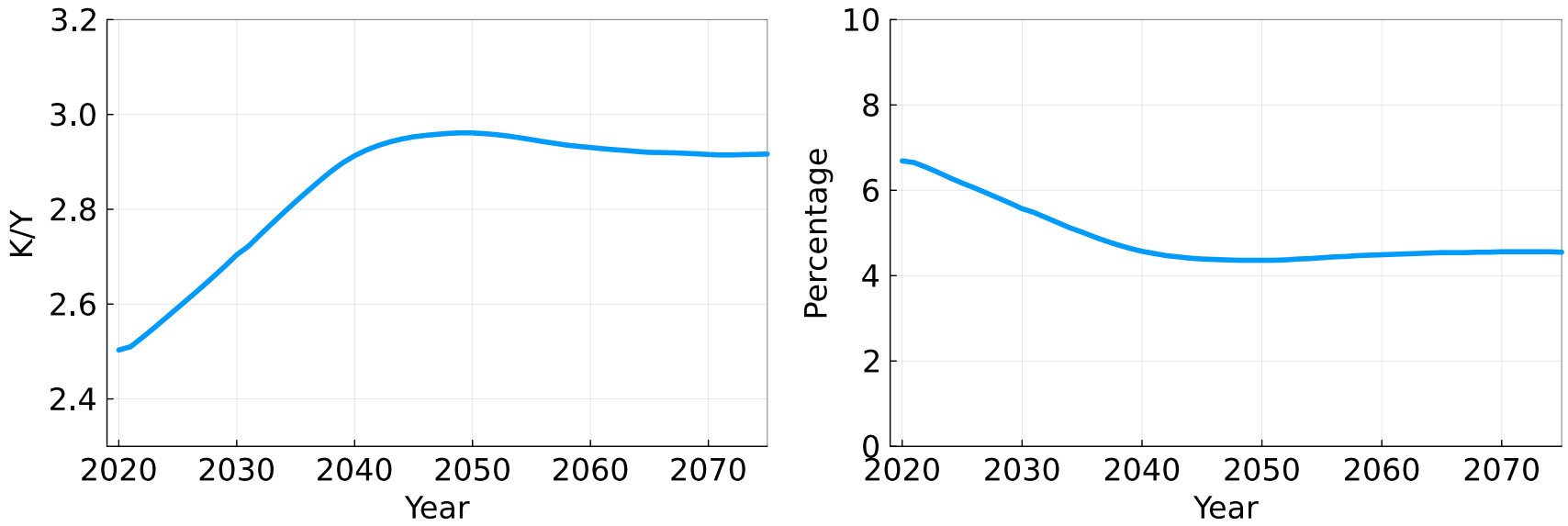
- Labor supply
  - Population size shrinks and dependency ratio increase
  - Additional labor supply: elderly, female, foreign workers
    - Female worker: Kitao and Mikoshiba (2020), Kitao and Mikoshiba (2023), Kitao and Nakakuni (2023)
    - Foreign worker: Shimasawa and Oguro (2010), Imrohoroglu et al. (2017), Kitao and Yamada (2021), Okamoto (2021)
- Savings and capital accumulation
  - Blanchard (2021,2023): arrival of low interest rate society
    - Goodhart and Pradhan (2020) has a different view
  - Population aging push down the rate of return from capital
    - Krueger and Ludwing (2007), Braun et al. (2007), Yamada (2012), Auclert et al. (2020)
  - Population aging also causes secular stagnation/low inflation rate
    - Eggertsson et al. (2019), Braun and Ikeda (2022)

Population Projection



Source: "Population Projections for Japan: 2021 to 2070" by The National Institute of Population and Social Security Research. Percentage of workers (15-64) reaches almost 50%.

Capital to Output Ratio (K/Y): Model



Left: Predicted K/Y path based on the model. Right: Predicted rate of return from capital calculated from the model. Return on capital is expected to decline by about 2% from the current level.

V. Conclusion

Conclusion: What's Next?

- Recent studies show that if this trend continues, public debt, measured as a ratio to GDP, will continue to increase
  - Sustainability is a great concern
- The relationship beweeen (a huge amount of) public debt and economic growth is still unclear
  - $\Rightarrow$ the economic growth alone cannot resolve the sustainability issue: Imrohoroğlu and Sudo (2011), Hansen and İmrohoroğlu (2016), Imrohoroğlu et al. (2016)
- Need more reseach on:
  - Family, marriage and female/male labor supply
  - Human capital: Vogel et al. (2017), Abbott et al. (2018)
  - Political feasibility: Conesa et al. (1999), Yamada (2011), Song et al. (2012), Muller et al. (2016)

Thank you!

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