Achieving Fiscal Balance in Japan

S. İmrohoroğlu, S. Kitao, and T. Yamada

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Several rounds of fiscal stimulus packages since early 1990s have resulted in the highest debt to GDP ratio in the developed world

Japan has the fastest aging population among the developed nations
- Public pension system
- Health expenditures

1. How severe demographic and fiscal challenges are
2. How various events and government policies may affect fiscal sustainability
Working Age Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Millions of individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>75</td>
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<tr>
<td>2020</td>
<td>70</td>
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<td>2030</td>
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<td>2050</td>
<td>55</td>
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</table>
Old-age Dependency Ratio

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>30</td>
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<tr>
<td>2020</td>
<td>40</td>
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<td>2050</td>
<td>70</td>
</tr>
<tr>
<td>2060</td>
<td>80</td>
</tr>
</tbody>
</table>
What We Do: Develop a Measurement Device

- A large scale overlapping generations model for Japan to evaluate the demographic change and fiscal challenges
  - individuals differ in age, gender, employment status, income, and asset holdings
  - incorporate the Japanese pension rules
  - incorporate estimated age-consumption and age-earnings profiles
- Calculate projections of future government budget balances, JGBs, and the pension fund
- Sensitivity and experiments
What We Do (cont.)

- Conduct “accounting” exercises
- Sensitivity
  - No macroeconomic slide, different wage growth rates, returns on the pension fund and JGBs, different fertility rates, different survival projections
- Policy experiments
  1. Pension rules
  2. Consumption tax
  3. Female labor force participation (FLFP) and compensation
Current policy and medium demographic projections lead to significant non-pension and pension deficits, and increasingly large interest burden on the budget.

Further pension reform is needed.

Increasing FLFP is important.
(Incomplete) List of Related Research

- İmrohoroglu and Sudo (2010, 2011)
- Braun and Joines (2011)
- Hoshi and Kashyap (2012)
- Hoshi and Ito (2012)
- Hansen and İmrohoroğlu (2011)
- Broda and Weinstein (2005), Doi, Hoshi, and Okimoto (2011)
Government Budget

\[ B_{t+1} - F_{t+1} = (1 + r_{b,t})B_t - (1 + r_{f,t})F_t + G_t + TR_t + P_t - T_t - PR_t \]

- \( B_t \): government debt, \( F_t \): pension fund
- \( G_t \): government purchases of goods and services, \( TR_t \): non-pension transfers to individuals,
- \( P_t \): pension benefits to retirees
- \( T_t \): tax revenue, \( PR_t \): pension premium
- \( r_{b,t} \): real interest rate on JGBs, \( r_{f,t} \): real return of the pension fund
Government Budget (cont.)

\[
T_t = \tau_{c,t} \sum_{i,j,e} c_{i,j,t} n_{i,j,e,t} + \tau_{a,t} r_{a,t} \sum_{i,j,e} a_{i,t} n_{i,j,e,t} \\
\tau_{l,t} \sum_{i,j,e} y_{i,j,e,t} n_{i,j,e,t} + \tau_{ls,t} \sum_{i,j,e} n_{i,j,e,t} \\
TR_t = \sum_{i,j,e} tr_t n_{i,j,e,t} \\
G_t = \sum_{i,j,e} g_t n_{i,j,e,t} \\
P_t = \sum_{i,j,e} p_{i,j,e,t} n_{i,j,e,t} \\
PR_t = \sum_{i,j,e} \tau_{p,t}(y_{i,j,e,t}) n_{i,j,e,t}
\]
Pension Benefit

- Pension benefits in Japan follow a three-tiered structure
  1. The basic pension (Kiso Nenkin)
  2. The employees’ pension insurance (Kosei Nenkin Hoken)
  3. Optional schemes (like private saving)

- The law of motion for the pension fund:

\[
F_{t+1} = (1 + r_{f,t})F_t + PR_t + X_t - P_t
\]

- \(X_t\): Contribution from the general government revenues to the payment of basic pension benefits
Model Overview

- A large scale overlapping generations model
- Consider Japanese economy from 2010 to 2100
  - $t = 2010, ..., 2100$
- \( \{i, j, e\} \): the age of an adult $i$, gender $j$, employment type $e$
  - $i \in \{1, ..., 91\}$
  - $j \in \{m, f\}$
  - $e \in \{R, C, S, U\}$: employed at a regular job (R), a contingent job (C), self-employed (S), or not working (U)
Demographics

- $\tilde{i}$: the age of an individual, $\tilde{i} \in \{1, \ldots, 111\}$.
  - enter the economy at adult age $l_A$
  - live up to $\tilde{i}$ years, but face the survival risk $s_{i,j,t}$
  - $i = \tilde{i} - l_A + 1$ if $\tilde{i} \geq l_A$
- $\tilde{n}_{i,j,e,t}$: the number of individuals of type $\{\tilde{i}, j, e\}$
- $\phi_{\tilde{i}, t}$: the fertility rate
Dependent Children

- Need consumption, income and asset profile to compute tax revenues
- Individual consumption profile depends on the number of dependent children
  - $\tilde{d}_{t,\tilde{i},k}$: the number of dependents of age $k$ that parents of age $\tilde{i}$ support at time $t$
  - $d_{t,\tilde{i}} = \sum_{k=1}^{I_i-1} \tilde{d}_{t,\tilde{i},k} o_k$: the total number of children for a mother of age $\tilde{i}$ at time $t$
Labor Force Participation and Earnings

Earnings of type \( \{i, j, e\} \) individuals at time \( t \) is \( y_{i,j,e,t} \).

Employment state: \( e \in \{R, C, S, U\} \)

- \( R \): regular job (seishain or seiki-koyou)
- \( C \): non-regular job (hi-seishain or hi-seiki-koyou)
- \( S \): self-employed
- \( U \): not working (unemployed or not in labor force)
Individuals’ Consumption Profiles

With complete markets:

\[
c_{i,j,t+i}(1 + \tau_{c,t+i})
\]

\[
= \hat{\lambda}_{i,t} \sum_{m=i_A}^{l} \frac{1}{\prod_{k=1}^{m} \left[ 1 + r_{a,t+k} (1 - \tau_{a,t+k}) \right]} S_{m,j,t+m}
\]

\[
\sum_{e} \frac{n_{m,j,e,t+m}}{\sum_{e} n_{m,j,e,t+m}} \left[ (1 - \tau_{l,t+m}) y_{m,j,e,t+m} - \tau_{p,t} (y_{m,j,e,t+m}) - \tau_{l,s,t} + \rho_{m,j,t+m} + tr_{m,j,e,t+m} \right]
\]
Earnings, Consumption and Asset Holdings

- Estimate $y_{i,j,e,t}$ from FIES
- Estimate $\tilde{\lambda}_i$ from FIES; $\lambda_{i,t} = \tilde{\lambda}_i (1 + d_{t,i} \nu)$
- Use $\hat{\lambda}_{i,t} = \lambda_{i,t} S_{i,j,t+i} / \prod_{k=1}^{i} [1 + r_{a,t+k} (1 - \tau_{a,t+k})]$.
  
  $S_{i,j,t+i} \equiv \prod_{k=1}^{i} s_{k,j,t+k}$
Now compute $c_{i,j,t+i}$ using permanent income hypothesis as shown above.

Compute the asset holdings at each age using the flow budget constraint:

\[
c_{i,j,t+i}(1 + \tau_{c,t+i}) + s_{i,j,t+i}a_{i+1,t+i+1} \\
= (1 - \tau_{l,t+i})y_{i,j,e,t+i} - \tau_{p,t+i}(y_{i,j,e,t+i}) \\
- \tau_{ls,t+i} + p_{i,j,t+i} + tr_{i,j,e,t+i} \\
+ [1 + r_{a,t+i}(1 - \tau_{a,t+i})]a_{i,t+i}
\]
Demographics

- Fertility/mortality rate:
  - estimates and projections by the National Institute of Population and Social Security Research (IPSS)
  - $t = 2010, \ldots, 2100$
- Population in 2010: Population Census

- Total fertility rates
- Life expectancy (male)
- Life expectancy (female)
Labor Market

- Labor force participation rate by gender and employment type (LFS):
  1. Regular worker
  2. Contracted worker
  3. Self-employed
  4. Not-in-labor force

- Earnings profile by gender and employment type (BSWS):
  - Labor force participation rate (male)
  - Labor force participation rate (female)
  - Earnings profiles (male)
  - Earnings profiles (female)
Government Debt and Pension Fund

- Net Government Debt $B_t$: 678.6 trillion yen.
  - liabilities: 786 tr. yen (central) and 184 tr. yen (local)
  - financial asset: 200 tr. yen (central) and 72 tr. yen (local)
- Initial pension fund $F_t$: 178.3 trillion yen.
  - includes mutual aid pension (KYOSAI)
  - excludes employees’ pension funds (Kosei Nenkin Kikin)
- Interest rates:
  - government bonds $r_b$: 1%
  - public pension fund $r_f$: 2%
  - private assets $r_a$: 3%
Public Pension System in Japan

- Basic Pension (Kiso Nenkin)
- Employees’ Pension Insurance (Kosei Nenkin Hoken)

Category 1
Category 2
Category 3
Public Pension

\[ p_{i,j,t} = (1 + x_{t,t-i}) \left[ p_{i,j,t}^b + \zeta_{t,t-i} \times \bar{y}_{i,j,t} \right], \quad (1) \]

- \( p_{i,j,t}^b \): basic pension for a retiree of age \( i \) and gender \( j \) at time \( t \)
- \( \zeta_{t,t-i} \): affects the replacement rate
- \( \bar{y}_{i,j,t} \): average past earnings

Due to past pension reforms, \( \zeta_{t,t-i} \) depends on the individual’s birth year \( t - i \)

We set \( \zeta_{t,t-i} \) to match the total amount of the second-tier payment with the data

\( x_{t,t-i} \) is the macroeconomic slide factor that is explained below.
Benefits and Contributions

- **Benefits**
  1. Kiso Nenkin: max ¥792,000 in 2010; we use ¥590,304 actual average for new recipients
  2. Kosei Nenkin: earnings-related

- **Contribution to the pension system:** \( \tau_p(y) \)
    - Contingent job workers and self-employed
    - Regular workers
Macroeconomic Slide

Given inflation rate $\pi_t$ and growth rate of real wages $g_t^w$, the slide factor $x_{t,t-i}$ is given by:

$$x_{t,t-i} = \left(1 + g_t^x\right)x_{t-1,t-1-i},$$
$$g_t^x = \begin{cases} \max\{g_t^* - s_t, 0\} & \text{if } g_t^* \geq 0, \\ g_t^* & \text{if } g_t^* < 0. \end{cases}$$

- New recipients (Shinki-saitei): $g_t^* = g_t^w + \pi_t$
- Existing recipients (Ki-saitei): $g_{t,t-i}^* = \pi_t$

Example: $\pi_t = 1.0\%$, $g_t^w = 2.0\%$ and $s_t = 0.9\%$

Without macro slide, 3.0\% annual increase in benefits for each successive cohort.
With macro slide, $3.0\% - 0.9\% = 2.1\%$.
For current retirees, an increase of only $1.0 - 0.9 = 0.1\%$. 
Government Budget

- **Tax rates:**
  - Consumption tax rate $\tau_c$: 5% in 2010 to 8% in 2014 to 10% in 2015
  - Capital income tax rate $\tau_a$: 35%
  - Labor income tax rate $\tau_l$: 10%
  - Lump-sum tax $\tau_{ls}$: adjust to match total revenue

- **Target total tax revenue in 2010:**
  - 78.6 trillion yen (central and local)

- **Gov’t expenditure and transfers in 2010:**
  - $G_t$: 77.6 trillion yen (central and local)
  - $TR_t$: 18.2 trillion yen
Consumption Profile

- Estimate $\lambda_i$ to match consumption profile
- Control cohort and year effects following Aguiar and Hurst (2009)

$$\ln C_{it} = \beta_0 + \beta_{age} D_{it}^{age} + \beta_c D_{it}^{cohort} + \beta_t D^{time} + \beta_{fam} X_{it} + \epsilon_{it}$$
Benchmark Transition

- Total population
- Projected GDP: 2010-2100
- Net government debt: % of GDP
- Source of net borrowing
- Government accounts
Total Population

![Graph showing the total population over time, with a downward trend from 2020 to 2100.](attachment:chart.png)
Working Population

- Introduction
- Model
- Calibration
- Benchmark Simulation
- Sensitivity Analysis
- Experiments
- Conclusion

### Working Population

- **Millions of individuals**
  - Year: 2020, 2040, 2060, 2080, 2100
  - Working population: 0, 50, 100

- **Working population growth rate**
  - Year: 2020, 2040, 2060, 2080, 2100
  - Percentage: -0.5, -1, -1.5, -2
GDP Dynamics

\[ GDP_{t+1} = (1 + g_t^w)(1 + g_t^n)GDP_t, \]

\( g_t^n \): working population growth rate
\( GDP_{2010} = 480 \text{ trillion yen} \)
\( g_t^w = 1.5\% = \text{also growth rate of GDP per worker} \)

GDP = (GDP per worker) \( \times \) working population

Growth rate of population exceeds growth rate of working population
Therefore GDP per capita grows less than 1.5\%
Projected GDP: 2010-2100

![Projected GDP Graph]

- **Trillion yen**
- **Year (2020-2100)**

The graph shows the projected GDP in trillion yen from 2010 to 2100, with a steady increase trend.
Projected GDP: 2010-2100

GDP per capita

Million yen

Year

2020 2040 2060 2080 2100

GDP per capita adjusted for growth

Million yen

Year

2020 2040 2060 2080 2100
Net Government Debt \((B_t - F_t)/Y_t\)

- 2020: 164%
- 2030: 211%
- 2040: 276%
- 2050: 377%
- 2060: 490%
Net Government Debt

Net Government debt (net of F; % of GDP)

Net Government debt (% of GDP)

Introduction
Model
Calibration
Benchmark Simulation
Sensitivity Analysis
Experiments
Conclusion

Net Government Debt

2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

0 500 1000 1500

Net Government debt (% of GDP)

Year
Percentage

2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

0 500 1000 1500

Percentage
Year
Sources of Net Borrowing

\[
\frac{(B_{t+1} - F_{t+1}) - (B_t - F_t)}{Y_t} = \frac{(G_t + TR_t - T_t)}{Y_t}
\]

\[
+ \frac{(P_t - PR_t)}{Y_t} + \frac{(r_{b,t}B_t - r_{f,t}F_t)}{Y_t}.
\]
Sources of Net Borrowing

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-Pension Deficit</th>
<th>Pension Deficit</th>
<th>Interest on Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td></td>
<td></td>
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<tr>
<td>2040</td>
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<td>2060</td>
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<td></td>
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<tr>
<td>2080</td>
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<td></td>
</tr>
<tr>
<td>2100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Government Accounts

**Govt Purchases**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 16%, 18%, 19%, 20%, 21%

**Transfer Payments**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 3%, 4%, 4.5%, 5%, 5%

**Pensions**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 1.5%, 2%, 2.5%, 3%

**Tax Revenue**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 6%, 6.5%, 7%, 7.5%

**Pension Premiums**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 15%, 18%, 20%, 22%

---

Government Accounts

**Govt Purchases**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 16%, 18%, 19%, 20%, 21%

**Transfer Payments**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 3%, 4%, 4.5%, 5%, 5%

**Pensions**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 1.5%, 2%, 2.5%, 3%

**Tax Revenue**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 6%, 6.5%, 7%, 7.5%

**Pension Premiums**

- Year: 2020, 2040, 2060, 2080, 2100
- Percentage: 15%, 18%, 20%, 22%
Replacement Rates

Japanese official definition

Standard definition: category-2 male
Pension Fund
Sensitivity of Benchmark Scenario

1. No macroeconomic slide
2. Different wage growth rates
3. Returns on the pension fund
4. Returns on the government debt
5. Different fertility projections
6. Different survival projections
Macroeconomic Slide and Pension Fund
Different Wage Growth Rates

\[
\frac{(B_t-F_t)}{Y_t} \quad g^w_t = 0.5\% \quad \text{Baseline (} g^w_t = 1.5\% \text{)} \quad g^w_t = 2.5\%
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>( g^w_t = 0.5% )</th>
<th>Baseline ( g^w_t = 1.5% )</th>
<th>( g^w_t = 2.5% )</th>
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<tbody>
<tr>
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<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
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<tr>
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<td>1.879</td>
<td>1.641</td>
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<tr>
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<td>4.007</td>
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<td>1.863</td>
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Wage Growth on Sources of Borrowing (1)

<table>
<thead>
<tr>
<th>Year</th>
<th>$g^w_t = 0.5%$</th>
<th>Baseline ($g^w_t = 1.5%$)</th>
<th>$g^w_t = 2.5%$</th>
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<tbody>
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<td>0.0202</td>
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<td>2060</td>
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</table>
## Wage Growth on Sources of Borrowing (2)

<table>
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<tr>
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<th>( g^w_t = 0.5% )</th>
<th>Baseline (( g^w_t = 1.5% ))</th>
<th>( g^w_t = 2.5% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( (P_t - PR_t) ) ( Y_t )</td>
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<td></td>
<td></td>
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<tr>
<td>2010</td>
<td>0.0395</td>
<td>0.0386</td>
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<tr>
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<td>0.0359</td>
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<td>0.0704</td>
<td>0.0515</td>
<td>0.0363</td>
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</table>
Wage Growth on Sources of Borrowing (3)

\[ g_t^w = 0.5\% \quad \text{Baseline} \quad (g_t^w = 1.5\%) \quad g_t^w = 2.5\% \]

\[
\frac{(r_{b,t} B_t - r_{f,t} F_t)}{Y_t}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>$g_t^w = 0.5%$</th>
<th>Baseline ($g_t^w = 1.5%$)</th>
<th>$g_t^w = 2.5%$</th>
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<td>0.0818</td>
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</table>
Different Returns on the Pension Fund

\[
\frac{(B_t - F_t)}{Y_t}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>( r_{f,t} = 1% )</th>
<th>Baseline ( (r_{f,t} = 2%) )</th>
<th>( r_{f,t} = 3% )</th>
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<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
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<tr>
<td>2020</td>
<td>1.673</td>
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<td>2.855</td>
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<tr>
<td>2060</td>
<td>5.028</td>
<td>4.898</td>
<td>4.664</td>
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- Small impact on the overall net debt
Different Returns on Government Debt

\[ \frac{(B_t - F_t)}{Y_t} \]

<table>
<thead>
<tr>
<th>Baseline</th>
<th>( r_{b,t} )</th>
<th>1%</th>
<th>2%</th>
<th>3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
</tr>
<tr>
<td>2020</td>
<td>1.334</td>
<td>1.481</td>
<td>1.641</td>
<td>1.816</td>
</tr>
<tr>
<td>2030</td>
<td>1.451</td>
<td>1.751</td>
<td>2.109</td>
<td>2.535</td>
</tr>
<tr>
<td>2040</td>
<td>1.680</td>
<td>2.151</td>
<td>2.762</td>
<td>3.555</td>
</tr>
<tr>
<td>2050</td>
<td>2.144</td>
<td>2.819</td>
<td>3.766</td>
<td>5.098</td>
</tr>
<tr>
<td>2060</td>
<td>2.637</td>
<td>3.540</td>
<td>4.898</td>
<td>6.964</td>
</tr>
</tbody>
</table>
Different Fertility Projections

$\frac{(B_t - F_t)}{Y_t}$

<table>
<thead>
<tr>
<th></th>
<th>Low Fertility</th>
<th>Baseline Fertility</th>
<th>High Fertility</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
</tr>
<tr>
<td>2020</td>
<td>1.638</td>
<td>1.641</td>
<td>1.644</td>
</tr>
<tr>
<td>2030</td>
<td>2.085</td>
<td>2.109</td>
<td>2.134</td>
</tr>
<tr>
<td>2040</td>
<td>2.729</td>
<td>2.762</td>
<td>2.800</td>
</tr>
<tr>
<td>2050</td>
<td>3.812</td>
<td>3.766</td>
<td>3.723</td>
</tr>
<tr>
<td>2060</td>
<td>5.144</td>
<td>4.898</td>
<td>4.680</td>
</tr>
</tbody>
</table>
## Different Survival Projections

Given the formula $\frac{(B_t - F_t)}{Y_t}$, the table below presents survival projections at different years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Low Survival</th>
<th>Baseline Survival</th>
<th>High Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
</tr>
<tr>
<td>2020</td>
<td>1.641</td>
<td>1.641</td>
<td>1.643</td>
</tr>
<tr>
<td>2030</td>
<td>2.096</td>
<td>2.109</td>
<td>2.113</td>
</tr>
<tr>
<td>2040</td>
<td>2.725</td>
<td>2.762</td>
<td>2.784</td>
</tr>
<tr>
<td>2050</td>
<td>3.690</td>
<td>3.766</td>
<td>3.820</td>
</tr>
<tr>
<td>2060</td>
<td>4.477</td>
<td>4.898</td>
<td>4.993</td>
</tr>
</tbody>
</table>
Policy Experiments

1. Pension rules
2. Consumption tax
3. Female labor force participation
Different Pension Rules

\[ \frac{(B_t - F_t)}{Y_t} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline</th>
<th>( i_R = 70 ) cut by 10%</th>
<th>Benefit cut by 10%</th>
<th>( i_R = 70 ) and Benefit cut by 10%</th>
<th>Earnings tax rate up by 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
</tr>
<tr>
<td>2020</td>
<td>1.641</td>
<td>1.625</td>
<td>1.518</td>
<td>1.504</td>
<td>1.639</td>
</tr>
<tr>
<td>2030</td>
<td>2.109</td>
<td>2.027</td>
<td>1.852</td>
<td>1.779</td>
<td>1.980</td>
</tr>
<tr>
<td>2040</td>
<td>2.762</td>
<td>2.478</td>
<td>2.339</td>
<td>2.083</td>
<td>2.417</td>
</tr>
<tr>
<td>2050</td>
<td>3.766</td>
<td>3.154</td>
<td>3.117</td>
<td>2.566</td>
<td>3.159</td>
</tr>
<tr>
<td>2060</td>
<td>4.898</td>
<td>3.964</td>
<td>3.996</td>
<td>3.147</td>
<td>3.994</td>
</tr>
</tbody>
</table>
Higher Consumption Tax Rates

\[ \frac{(B_t - F_t)}{Y_t} \]

<table>
<thead>
<tr>
<th>Year</th>
<th>(\tau_{c,t} = 10%)</th>
<th>(\tau_{c,t} = 15%)</th>
<th>(\tau_{c,t} = 20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
</tr>
<tr>
<td>2020</td>
<td>1.641</td>
<td>1.590</td>
<td>1.581</td>
</tr>
<tr>
<td>2030</td>
<td>2.109</td>
<td>1.849</td>
<td>1.696</td>
</tr>
<tr>
<td>2040</td>
<td>2.762</td>
<td>2.279</td>
<td>1.916</td>
</tr>
<tr>
<td>2050</td>
<td>3.766</td>
<td>3.027</td>
<td>2.430</td>
</tr>
<tr>
<td>2060</td>
<td>4.898</td>
<td>3.891</td>
<td>3.050</td>
</tr>
</tbody>
</table>
Consumption Tax and Net Borrowing

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>-0.02</td>
</tr>
<tr>
<td>2020</td>
<td>0</td>
</tr>
<tr>
<td>2030</td>
<td>0.02</td>
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<tr>
<td>2040</td>
<td>0.04</td>
</tr>
<tr>
<td>2050</td>
<td>0.06</td>
</tr>
<tr>
<td>2060</td>
<td>0.08</td>
</tr>
<tr>
<td>2070</td>
<td>0.10</td>
</tr>
<tr>
<td>2080</td>
<td></td>
</tr>
<tr>
<td>2090</td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td></td>
</tr>
</tbody>
</table>

- Non-Pension Deficit
- Pension Deficit
- Interest on Debt
Female Labor Force Participation

\[
\frac{(B_t - F_t)}{Y_t}
\]

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline</th>
<th>FLFP (A)</th>
<th>FLFP (B)</th>
<th>FLFP (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
<td>1.042</td>
</tr>
<tr>
<td>2020</td>
<td>1.641</td>
<td>1.513</td>
<td>1.611</td>
<td>1.474</td>
</tr>
<tr>
<td>2030</td>
<td>2.109</td>
<td>1.757</td>
<td>1.968</td>
<td>1.591</td>
</tr>
<tr>
<td>2040</td>
<td>2.762</td>
<td>2.208</td>
<td>2.453</td>
<td>1.844</td>
</tr>
<tr>
<td>2050</td>
<td>3.766</td>
<td>2.940</td>
<td>3.265</td>
<td>2.351</td>
</tr>
<tr>
<td>2060</td>
<td>4.898</td>
<td>3.788</td>
<td>4.204</td>
<td>2.960</td>
</tr>
</tbody>
</table>
FLFP and Net Borrowing

Contribution to Net Borrowing

Year
Percentage (%)
Non-Pension Deficit
Pension Deficit
Interest on Debt

FLFP and Net Borrowing
Conclusion

- Significant fiscal risks ahead
- Unfavorable bond yields can make things worse
- Further pension reform (raising retirement age)
- FLFP important
- to do:
  - Immigration
  - Endogenous Consumption/Saving and Labor/Leisure in General Equilibrium
  - Endogenous Female Labor Force Participation
Life Expectancy: Male

![Graph showing life expectancy trends for males from 2010 to 2060. The graph includes three lines representing high, benchmark, and low scenarios. The x-axis represents the years 2010 to 2060, and the y-axis represents life expectancy from 78 to 86 years. The high scenario shows a steady increase, the benchmark scenario shows a moderate increase, and the low scenario shows a slow increase.](Image)
Life Expectancy: Female

- **Introduction**
- **Model**
- **Calibration**
- **Benchmark Simulation**
- **Sensitivity Analysis**
- **Experiments**
- **Conclusion**

### Life Expectancy: Female

#### Year: 2010 to 2060

- **High Benchmark**
- **Benchmark**
- **Low**

<table>
<thead>
<tr>
<th>Year</th>
<th>High</th>
<th>Benchmark</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>86</td>
<td>87</td>
<td>85</td>
</tr>
<tr>
<td>2020</td>
<td>87</td>
<td>88</td>
<td>86</td>
</tr>
<tr>
<td>2030</td>
<td>88</td>
<td>89</td>
<td>87</td>
</tr>
<tr>
<td>2040</td>
<td>89</td>
<td>90</td>
<td>88</td>
</tr>
<tr>
<td>2050</td>
<td>90</td>
<td>91</td>
<td>89</td>
</tr>
<tr>
<td>2060</td>
<td>91</td>
<td>92</td>
<td>90</td>
</tr>
</tbody>
</table>
Labor Force Participation Rate

![Graph showing labor force participation rates by age for different categories: regular, regular + contingent, and regular + contingent + self.]
Labor Force Participation Rate

![Graph showing labor force participation rate by age and employment type.](image)

- **Regular + Contingent + Self**
- **Regular + Contingent**
- **Regular**

**Axes:**
- **X-axis:** Age
- **Y-axis:** Percentage

**Legend:**
- Blue line: regular + contingent + self
- Green dashed line: regular + contingent
- Red dashed line: regular
Earnings Profile: Male
Earnings Profile: Female

![Graph showing earnings profile for females with age on the x-axis and million yen on the y-axis. The graph compares regular, contingent, and self-employed earnings.]
Consumption Profile