Fiscal Reform and Government Debt in Japan: A Neoclassical Perspective

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Basic Issue

- Two significant challenges faced by Japan
  - High debt to output ratio (close to 150%).
  - Projected increase in government expenditures due to aging population.
    - Spending to output projected to rise by 7% due to increases in pension and health spending.
- We explore size and consequences of fiscal responses to this problem.
High Debt

Figure: Net Debt to GNP Ratio
Aging Population

Figure: Dependency Ratios
Implications of Aging Population
Fukawa and Sato (2009)

Figure: Government Expenditures to GNP Ratios
What We Do

- Formulate and calibrate neoclassical growth model of Japan.
- How much revenue must be raised to achieve fiscal balance in Japan?
- How large must tax rates on labor and/or consumption be to achieve this goal?
- How would these tax increases impact the Japanese economy?
What We Do

- Economic agents have perfect foresight.
- Characterize how model performs from 1981-2010.
  - Take as exogenous TFP, tax rates, government consumption, transfers and population.
  - Use observed values 1981-2010.
- Use model to forecast from 2011 and beyond.
  - Government projections for population to 2050.
  - Forecasts of Fukawa and Sato (2009) of $G/Y$ and $TR/Y$ to 2050. [Consistent with independent projections of İmrohoroğlu, Kitao, and Yamada (2013)]
Features of Model

- Government debt is introduced with bond price (interest rate) endogenous.
  - Government bonds enter utility function $\Rightarrow$ rate of return dominance.
- Endogenous labor choice $\Rightarrow$ consumption and labor income taxes are distorting.
- "Fiscal Sustainability Rule" insures that intertemporal government budget constraint is satisfied.
Related Literature

  - Compute revenue required to stabilize debt at 2010 level.
- Hoshi and Ito, “Defying Gravity: How long will Japanese Government Bond Prices Remain High?”
  - How much government debt will the Japanese hold?
    - Find debt to output ratio of 246%.
Model: Government Budget

\[ G_t + TR^*_t + B_t = \eta_t q_t B_{t+1} + \tau_{c,t} C_t + \tau_{h,t} W_t h_t \]
\[ + \tau_{k,t} (r_t - \delta) K_t + \tau_{b,t} (1 - q_{t-1}) B_t. \]

\[ \iota_t = \begin{cases} 
1 & \text{if } B_{s}/Y_s \geq b_{\text{max}} \text{ for some } s \leq t, \\
0 & \text{otherwise}
\end{cases} \]

\[ D_t = \kappa \iota_t (B_t - \overline{B}_t), \]
\[ TR^*_t = TR_t - D_t \]
Model: Household’s Problem

\[
\max \sum_{t=0}^{\infty} \beta^t N_t[\log C_t - \alpha \frac{h_t^{1+1/\psi}}{1 + 1/\psi} + \phi \log(\mu_t + B_{t+1})]
\]

subject to

\[
(1 + \tau_{c,t}) C_t + \eta_t K_{t+1} + q_t \eta_t B_{t+1}
= (1 - \tau_{h,t}) W_t h_t + [(1 + (1 - \tau_{k,t})(r_t - \delta)) K_t
+ [1 - (1 - q_{t-1}) \tau_{b,t}] B_t + TR_t,
\]
Model: Firm’s Problem

\[ N_t Y_t = A_t (N_t K_t)^\theta (N_t h_t)^{1-\theta} \]
\[ N_{t+1} K_{t+1} = (1 - \delta) N_t K_t + N_t X_t \]
\[ A_{t+1} = \gamma_t A_t \]
Stationary Equilibrium Conditions

Given a per capita variable $Z_t$ we obtain its detrended counterpart

$$z_t = \frac{Z_t}{A_t^{1/(1-\theta)}}.$$ 

- First order conditions and market clearing conditions combine to give 10 equations in 10 unknowns $\{c_t, x_t, h_t, y_t, k_{t+1}, b_{t+1}, d_t, q_t, w_t, r_t\}$ for each period $t$.
- Computation Objective: Find value for $k_1$ such that sequence converges to steady state.
Population and Labor Input

- $N_t =$ working age population between the ages of 20 and 69
- Use actual values for 1981-2010
- Use official projections for 2011-2050
- Population constant after 2050
- $h_t$ is employment per working age population multiplied by average weekly hours worked divided by 98 (discretionary hours available per week).

Table: Adjustments to National Account Measurements

\[ C = \text{Private Consumption Expenditures} \]

\[ I = \text{Private Gross Investment} \]
\[ + \text{Change in Inventories} \]
\[ + \text{Net Exports} \]
\[ + \text{Net Factor Payments from Abroad} \]

\[ G = \text{Government Final Consumption Expenditures} \]
\[ + \text{General Government Gross Capital Formation} \]
\[ + \text{Government Net Land Purchases} \]
\[ - \text{Book Value Depreciation of Government Capital} \]

\[ Y = C + I + G \]
Government Accounts

- Public health expenditures in Japan are included in $G_t$.
- $TR_t$, includes social benefits (other than those in kind, which are in $G_t$,) that are mostly public pensions, plus other current net transfers minus net indirect taxes.
- 8% of output is added to $TR_t$ since modeling of flat tax rates ignores deductions and exemptions.
Tax Rates

- $\tau_{h,t}$, are average marginal labor income tax rates estimated by Gunji and Miyazaki (2011).
  - Last value is 0.324 for 2007 and we assume that this remains constant thereafter.

- $\tau_{k,t}$, is constructed following methodology in Hayashi and Prescott (2002).
  - Last value is 0.3557 for 2010 and we assume that this remains constant thereafter.
Tax Rates, continued

- **Tax Rate on Consumption, $\tau_{c,t}$**
  - 0% 1981-1988
  - 3% 1989-1996
  - 5% 1997-2013
  - 8% 2014
  - 10% 2015 and beyond.

- **Tax Rate on Bond Interest, $\tau_b$, 20% for all time periods.**
Tax Rates, continued

Figure: Tax Rates
Technology Parameters

- \( A_t = \frac{Y_t}{(K_t^\theta h_t^{1-\theta})} \).
- \( \theta = 0.378 \), which is the average value from 1981-2010.
- \( \gamma_t = \frac{A_{t+1}}{A_t} \), comes from the actual data between 1981 and 2010.
- \( \gamma_t = 1.015^{1-\theta} \) for 2011 and beyond.
- \( \delta = 0.0842 \), which is the average value from 1981-2010.
Preference Parameters

- Five preference parameters, $\beta, \alpha, \psi, \phi$, and $\mu$.
- $\mu = \mu_t / A_t^{1/(1-\theta)} = 1.1$.
- $\psi = 0.5$, the Frisch elasticity of labor supply estimated by Chetty et al (2012).
For $\beta$, $\alpha$, and $\phi$, use equilibrium conditions to obtain a value for each year, and then average over the sample:

$$
\beta_t = \frac{(1 + \tau_{c,t+1}) \gamma_t^{1/(1-\theta)} c_{t+1}}{(1 + \tau_{c,t}) c_t \left[ 1 + (1 - \tau_{k,t+1}) \left( \theta \frac{y_{t+1}}{k_{t+1}} - \delta \right) \right]}
$$

$$
\alpha_t = \frac{h_t^{-1/\psi} (1 - \tau_{h,t})(1 - \theta) y_t}{(1 + \tau_{c,t}) c_t h_t}
$$

$$
\phi_t = \eta_t (\mu + b_{t+1}) \left[ \frac{q_t \gamma_t^{1/(1-\theta)}}{(1 + \tau_{c,t}) c_t} - \frac{\beta_t [1 - (1 - q_t) \tau_{b,t+1}]}{(1 + \tau_{c,t+1}) c_{t+1}} \right].
$$
Need empirical counterpart to $q_t$:

$$q_t = \frac{B_{t+1}/F_t}{(B_{t+1} + P_{t+1})/F_{t+1}}.$$

- $B_t$ is beginning of period debt.
- $P_t$ is interest payments made in period $t$.
- $F_t$ is the GNP deflator.
Figure: Bond Prices
# Structural Parameters

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<th>Parameter</th>
<th>Value</th>
<th>Source/Notes</th>
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<td>Data Average</td>
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<tr>
<td>$\delta$</td>
<td>0.0842</td>
<td>Data Average</td>
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<td>$\beta$</td>
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<td>FOC, 1981-2010</td>
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<tr>
<td>$\alpha$</td>
<td>22.6331</td>
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<td>$\psi$</td>
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<td>Chetty et al (2012)</td>
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<td>$\phi$</td>
<td>0.063</td>
<td>FOC, 1981-2010</td>
</tr>
<tr>
<td>$\mu$</td>
<td>1.1</td>
<td>fit $q_t$ for 1981-2010</td>
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</tbody>
</table>
Fiscal Sustainability

\[ d_t = \kappa \ell_t (b_t - \bar{b} \bar{y}), \]

\[ \ell_t = \begin{cases} 1 & \text{if } B_s/Y_s \geq b_{\text{max}} \text{ for some } s \leq t, \\ 0 & \text{otherwise} \end{cases} \]

- \( \bar{b} = 0.6 \)
- Consider \( b_{\text{max}} = 200\%, 250\% \) and 300\%.
- Japan already near 150\%.
- Different value of \( \kappa \) for each \( b_{\text{max}} \).
Fiscal Sustainability

Figure: Revenue Requirement in the Benchmark Economy
Fiscal Sustainability

Figure: Bond to Output Ratio for Alternative Maximum Debt to GNP Ratios
Fiscal Sustainability

Figure: Revenue Requirement for Alternative Maximum Debt to GNP Ratios
Comparison of Benchmark with Data

Figure: Labor, Capital, and Output
Comparison of Benchmark with Data

Figure: Consumption, Investment, and Capital-Output Ratio
Comparison of Benchmark with Data

Figure: Bond to Output Ratio
Government Finance in Steady State

Labor Tax

Figure: Labor Income Tax Laffer Curve
Government Finance in Steady State

Consumption Tax

Figure: Consumption Tax Laffer Curve
From first order condition for labor, can define

\[ 1 - \tau_t \equiv \frac{1 - \tau_{h,t}}{1 + \tau_{c,t}} \]

\[ \Rightarrow \tau_t = \frac{\tau_{c,t} + \tau_{h,t}}{1 + \tau_{c,t}} \]
Government Finance in Steady State

Iso-Revenue Curve
Implementation of Tax Increases

\[ \tau_{x,t} = \begin{cases} \tau^B_x, & \text{if } t < T_1(B_s/Y_s \leq b_{\text{max}} \text{ for all } s \leq t) \\ \tau_x + \pi, & \text{if } T_1 \leq t < T_2(B_s/Y_s > b_{\text{max}} \text{ for some } s \leq t \text{ and } B_t/Y_t > \bar{b}) \\ \tau_x, & \text{if } t \geq T_2(B_t/Y_t \leq \bar{b}), \end{cases} \]

where \( x = c \) or \( h \).

- \( \pi \) is chosen as the smallest increment that leads to the activation of the second trigger (convergence to steady state).
Fiscal Policy Experiments

When debt reaches trigger ...

1. Raise $\tau_c$ only.
2. Raise $\tau_c$ and set $TR_t = TR_t^B - 0.08 Y_t$.
3. Raise $\tau_h$ and set $\tau_{c,t} = \tau_{c,t}^B + 0.3$.
4. Raise $\tau_h$ and set $\tau_{c,t} = \tau_{c,t}^B + 0.3$ and $TR_t = TR_t^B - 0.08 Y_t$.
5. Raise $\tau_h$ and set $\tau_{c,t} = \tau_{c,t}^B + 0.05$ and $TR_t = TR_t^B - 0.08 Y_t$. 
Increase Consumption Tax Only

Figure: Consumption Tax Experiments
Increase Both Consumption and Labor Tax
Raise labor tax to retire debt, permanent increase in consumption tax so this is possible.

Figure: Labor Income Tax Rate
Transition Paths for Various Experiments

Figure: Labor, Capital, and Output
Transition Paths for Various Experiments

Figure: Consumption and Investment
Transition Paths for Various Experiments

Figure: Debt to GNP Ratio
Effective Tax Distortion

Figure: Effective Tax Rate
Conclusion

- Soaring debt to GNP ratio implies fiscal “day of reckoning” is soon – around 2020.
- Costs of aging population require large nearly permanent increases in tax rates:
  - Consumption tax: permanent increase to 48% with additional 12% during transition.
  - Both consumption and labor tax: permanent increase to 40%, smaller additional increase during transition.
Other options to explore:

- Social security and health insurance reform.
- Increase fertility and/or allow immigration.
- Encourage female labor force participation.
- Raise retirement age.