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
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.
- Calculate effects of alternative fiscal policies designed to achieve fiscal balance.
- How large must tax rates on labor and/or consumption be to achieve this goal?
- First consider reducing transfers (lump taxes) and then consider distorting taxes.
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.
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

- İmrohoroğlu and Sudo, “Productivity and Fiscal Policy in Japan: Short Term Forecasts from the Standard Growth Model”
  - Experiment with policies to eliminate budget deficit in near future by increasing consumption tax.
- İmrohoroğlu and Sudo, “Will a Growth Miracle Reduce Debt in Japan”
  - Assess possibility that high TFP growth could eliminate government debt.
Model: Government Budget

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

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

\[ D_t = \kappa \iota_t (B_t - \bar{B}_t), \]

\[ TR^*_t = TR_t - D_t \]
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

\[
\begin{align*}
C &= \text{Private Consumption Expenditures} \\
I &= \text{Private Gross Investment} \\
&\quad + \text{Change in Inventories} \\
&\quad + \text{Net Exports} \\
&\quad + \text{Net Factor Payments from Abroad} \\
G &= \text{Government Final Consumption Expenditures} \\
&\quad + \text{General Government Gross Capital Formation} \\
&\quad + \text{Government Net Land Purchases} \\
&\quad - \text{Book Value Depreciation of Government Capital} \\
Y &= C + I + G
\end{align*}
\]
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.
- 8.1% 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

- $A_t = Y_t / \left( K_t^\theta h_t^{1-\theta} \right)$.
- $\theta = 0.378$, which is the average value from 1981-2010.
- $\gamma_t = A_{t+1}/A_t$, 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).
Preference Parameters, continued

For $\beta$, $\alpha$, and $\phi$, use equilibrium conditions to obtain a value for each year, and then average over the sample:

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

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

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

Figure: Bond Prices
Figure: Returns on Capital and Bonds
### Structural Parameters

**Table: Calibration of Structural Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ</td>
<td>0.3783</td>
<td>Data Average</td>
</tr>
<tr>
<td>δ</td>
<td>0.0842</td>
<td>Data Average</td>
</tr>
<tr>
<td>β</td>
<td>0.9677</td>
<td>FOC, 1981-2010</td>
</tr>
<tr>
<td>α</td>
<td>22.6331</td>
<td>FOC, 1981-2010</td>
</tr>
<tr>
<td>ψ</td>
<td>0.5</td>
<td>Chetty et al (2012)</td>
</tr>
<tr>
<td>φ</td>
<td>0.063</td>
<td>FOC, 1981-2010</td>
</tr>
<tr>
<td>μ</td>
<td>1.1</td>
<td>fit ( q_t ) for 1981-2010</td>
</tr>
</tbody>
</table>
Fiscal Sustainability

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

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

- \( \bar{b} = 0.6 \)
- 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
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

Consumption Tax

Figure: Consumption Tax Laffer Curve
Government Finance in Steady State

Labor Tax

Figure: Labor Income Tax Laffer Curve
Tax Wedge

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
Combination of Taxes

![Graph showing the relationship between labor income tax rate, consumption tax rate, and effective tax rate.](#)
Implementation of Tax Increases

\[
\tau_{x,t} = \begin{cases} 
\tau_{x,\text{last}} & \text{if } B_s / Y_s \leq b_{\text{max}} \text{ for all } s \leq t \\
\bar{\tau}_x + \pi & \text{if } B_s / Y_s > b_{\text{max}} \text{ for some } s \leq t \text{ and } B_t / Y_t > \bar{b} \\
\bar{\tau}_x & \text{if } B_t / Y_t \leq \bar{b}.
\end{cases}
\]

where \( x = c \) or \( h \) and \( t \geq 2015 \).

- \( \pi \) is chosen as the smallest increment that leads to the activation of the second trigger (convergence to steady state).
Increase Consumption Tax Only

Figure: Consumption Tax Experiment 1
Increase Both Consumption and Labor Tax
Use Consumption Tax to Retire Debt, Increase Labor Tax to 45%.

Figure: Consumption Tax Experiment 2
Increase Both Consumption and Labor Tax
Use Labor Tax to Retire Debt, Increase Consumption Tax to 40%.

Figure: Labor Income Tax Rate
Transition Paths for Various Experiments

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

Figure: Consumption and Investment
Figure: Debt to GNP Ratio
Effective Tax Distortion

Figure: Effective Tax Rate
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.
Conclusion

- Other options to explore:
  - Broaden tax base: 8.1% of GNP potential.
  - Social security and health insurance reform.
  - Increase fertility and/or allow immigration.
  - Encourage female labor force participation.
  - Reduce spending.