Fiscal Reform and Government Debt in Japan: A Neoclassical Perspective

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October 5, 2013

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

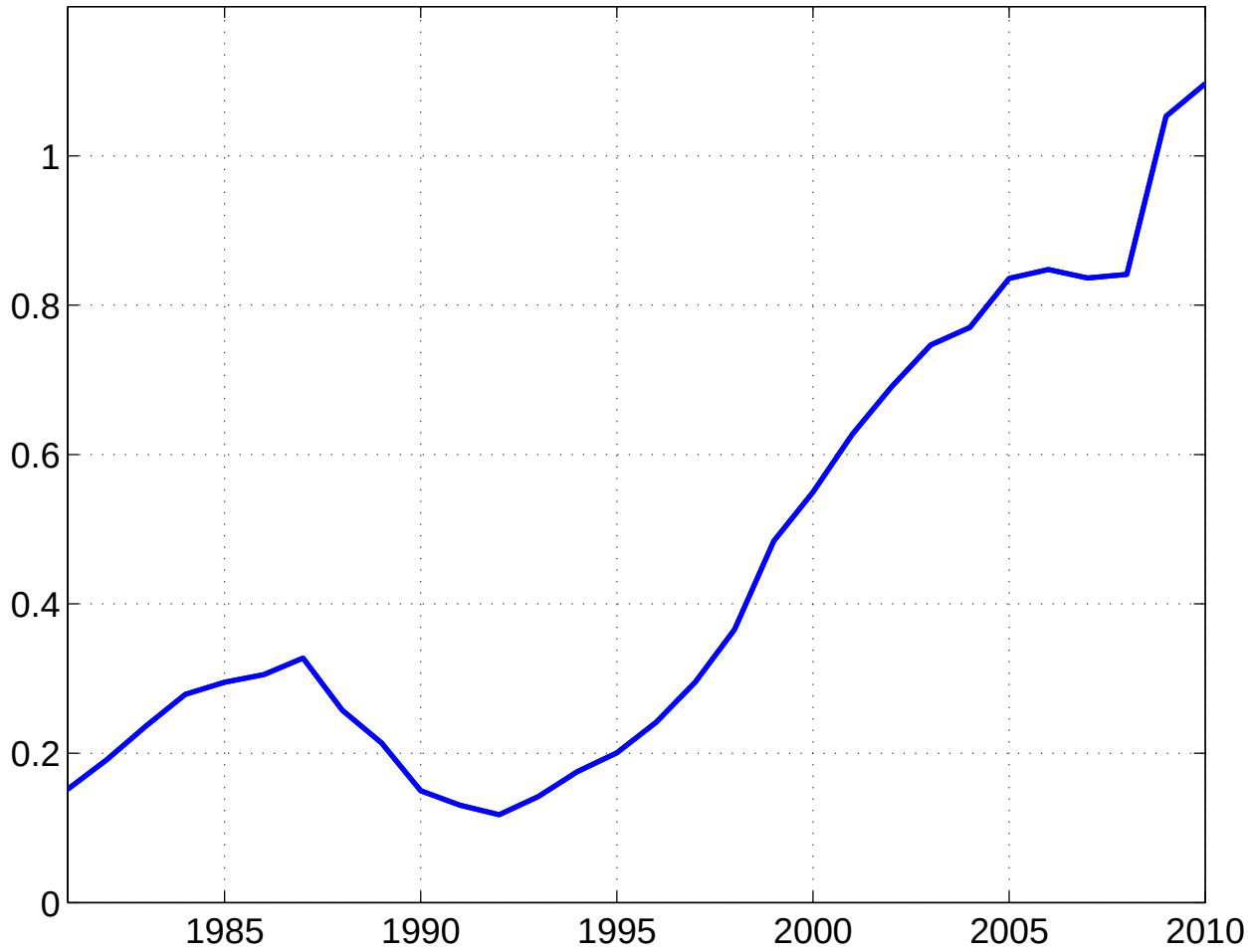


Figure : Net Debt to GNP Ratio

Aging Population

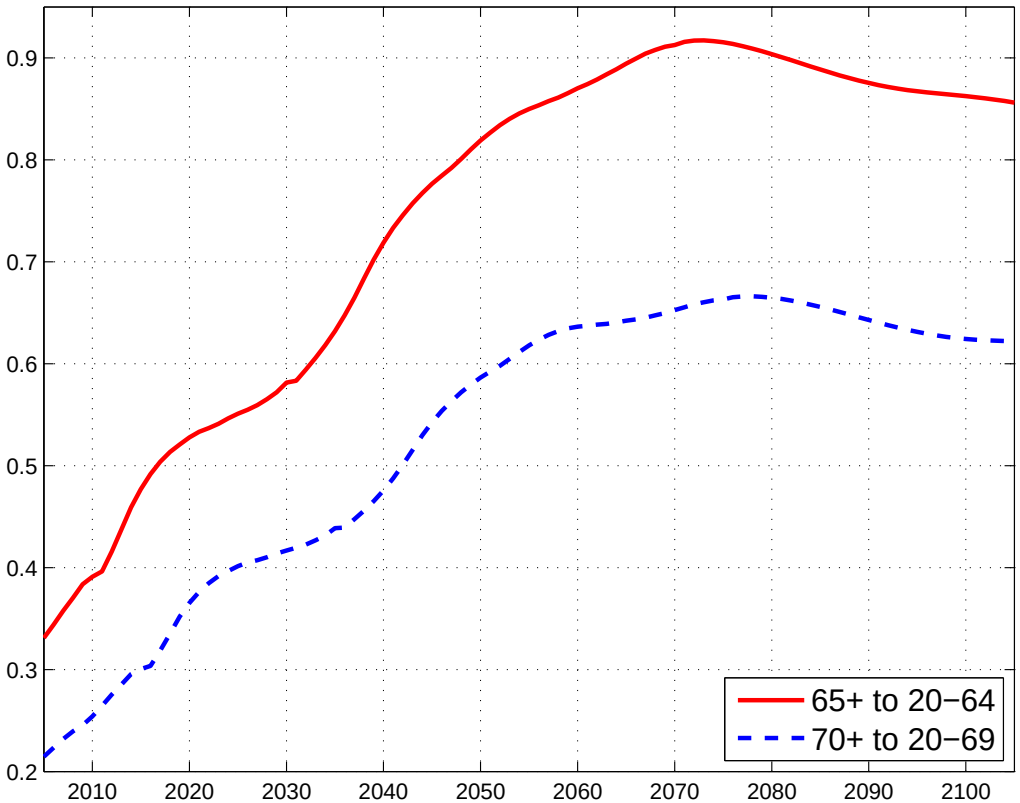


Figure : Dependency Ratios

Implications of Aging Population

Fukawa and Sato (2009)

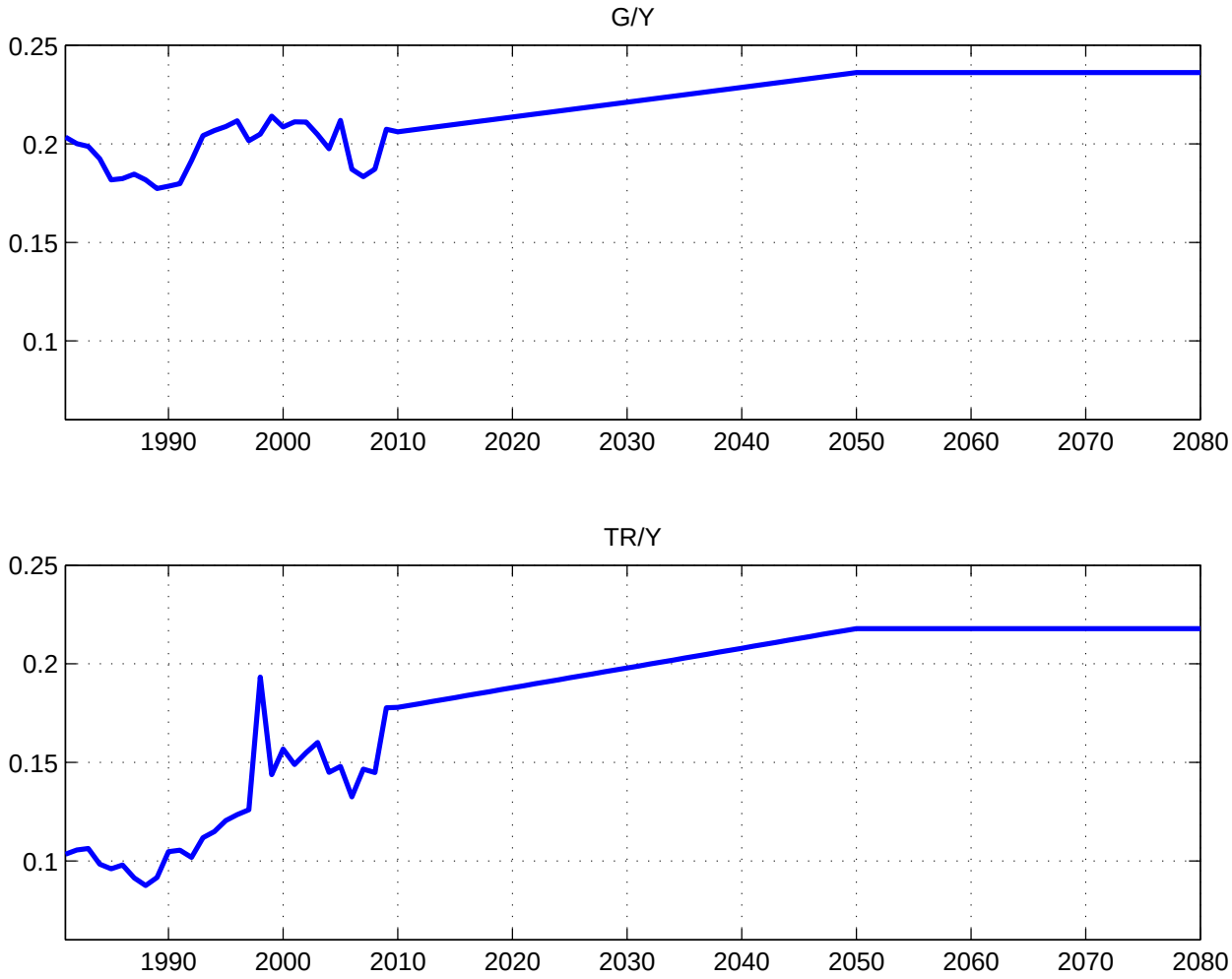


Figure : Government Expenditures to GNP Ratios

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

- Hayashi and Prescott (2002) and Chen, İmrohoroğlu and İmrohoroğlu (2006).
- 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

- Doi, Hoshi and Okimoto (2011), "Japanese Government Debt and Sustainability of Fiscal Policy.".
  - 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

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

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

$$D_t = \kappa \iota_t (B_t - \overline{B}_t),$$

$$TR_t^* = TR_t - D_t$$

Model: Household's Problem

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

subject to

$$\begin{aligned}
&(1+\tau_{c,t})C_t + \eta_t K_{t+1} + q_t \eta_t B_{t+1} \\
&= (1-\tau_{h,t}) W_t h_t + \left[(1+(1-\tau_{k,t})(r_t-\delta)\right] K_t \\
&+ \left[1-(1-q_{t-1})\tau_{b,t}\right] B_t + TR_t,
\end{aligned}$$

Model: Firm's Problem

$$
\begin{aligned}
N_t Y_t &= A_t (N_t K_t)^{\theta} (N_t h_t)^{1-\theta} \\
N_{t+1} K_{t+1} &= (1-\delta) N_t K_t + N_t X_t \\
A_{t+1} &= \gamma_t A_t
\end{aligned}
$$

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).

National Accounts: Hayashi and Prescott (2002)

Table : Adjustments to National Account Measurements

$C =$	Private Consumption Expenditures
$I =$	Private Gross Investment
	$+$ Change in Inventories
	$+$ Net Exports
	$+$ Net Factor Payments from Abroad
$G =$	Government Final Consumption Expenditures
	$+$ General Government Gross Capital Formation
	$+$ Government Net Land Purchases
	$-$ 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, τ_b, 20% for all time periods.

Tax Rates, continued

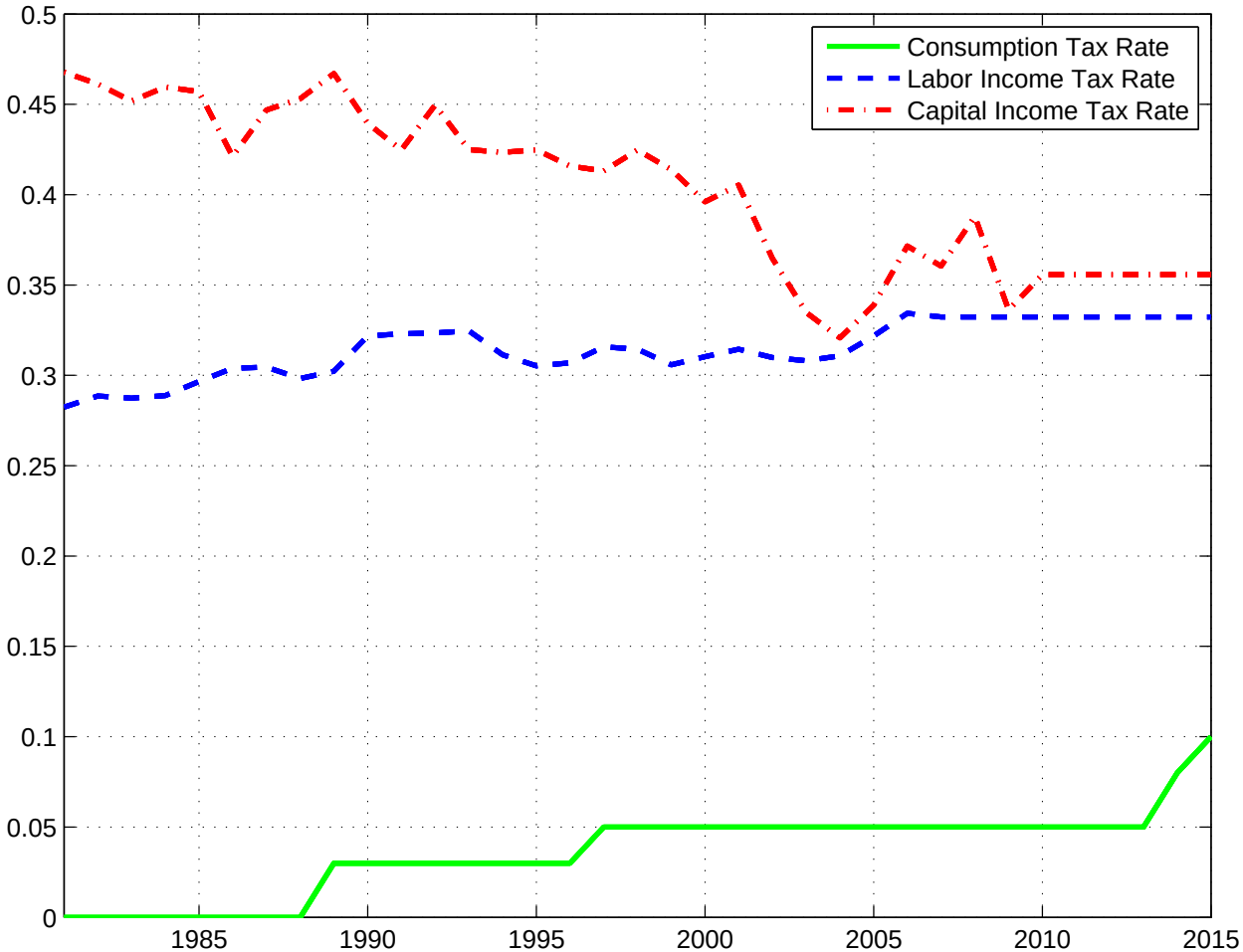


Figure : Tax Rates

Technology Parameters

- $A_t = Y_t/(K_t^{\theta} h_t^{1-\theta})$.
- $\theta = 0.378$, 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 μ.
- $\mu = \mu_t / A_t^{1/(1-\theta)} = 1.1$.
- $\psi = 0.5$, the Frisch elasticity of labor supply estimated by Chetty et al (2012).

Preference Parameters, continued

For β, α, and ϕ, use equilibrium conditions to obtain a value for each year, and then average over the sample:

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

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

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

Bond Price

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

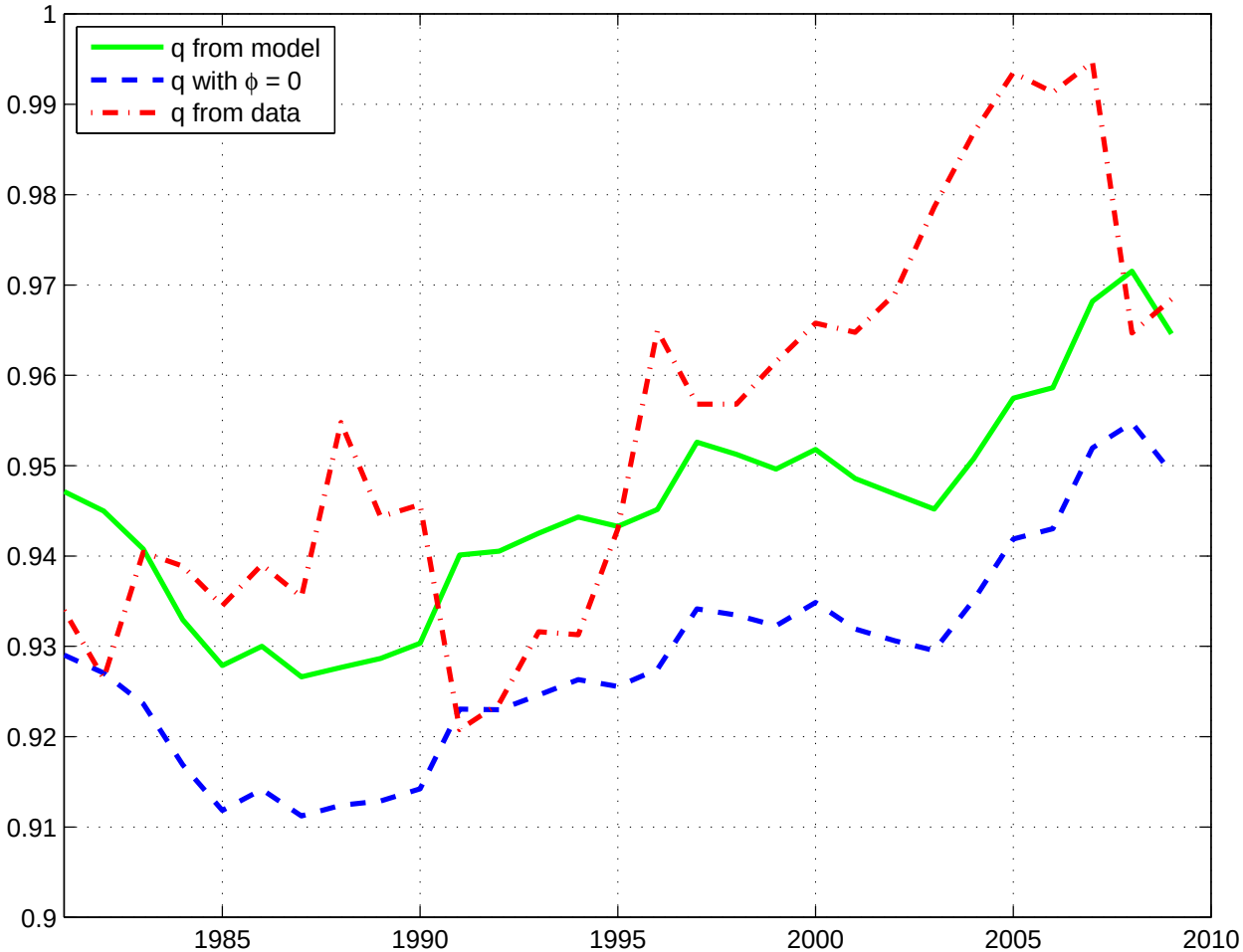


Figure : Bond Prices

Structural Parameters

Table : Calibration of Structural Parameters

Parameter	Value	
θ	0.3783	Data Average
δ	0.0842	Data Average
β	0.9677	FOC, 1981-2010
α	22.6331	FOC, 1981-2010
ψ	0.5	Chetty et al (2012)
ϕ	0.063	FOC, 1981-2010
μ	1.1	fit q_t for 1981-2010

Fiscal Sustainability

$$d_t = \kappa \iota_t (b_t - \overline{b}\, \overline{y}),$$

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

- $\overline{b} = 0.6$
- Consider $b_{\max} = 200\%$, 250% and 300%.
- Japan already near 150%.
- Different value of κ for each $b_{\max}$.

Fiscal Sustainability

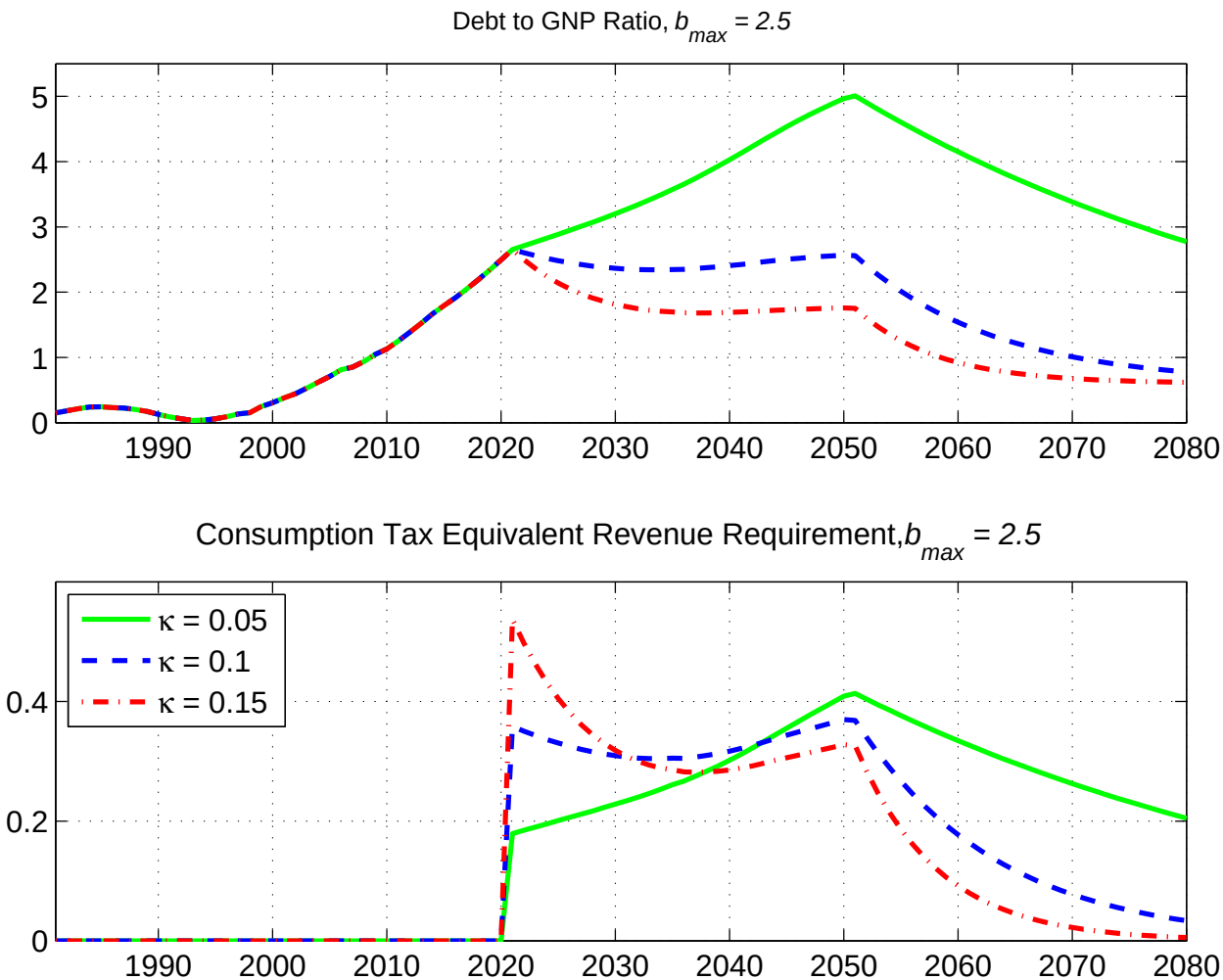


Figure : Revenue Requirement in the Benchmark Economy

Fiscal Sustainability

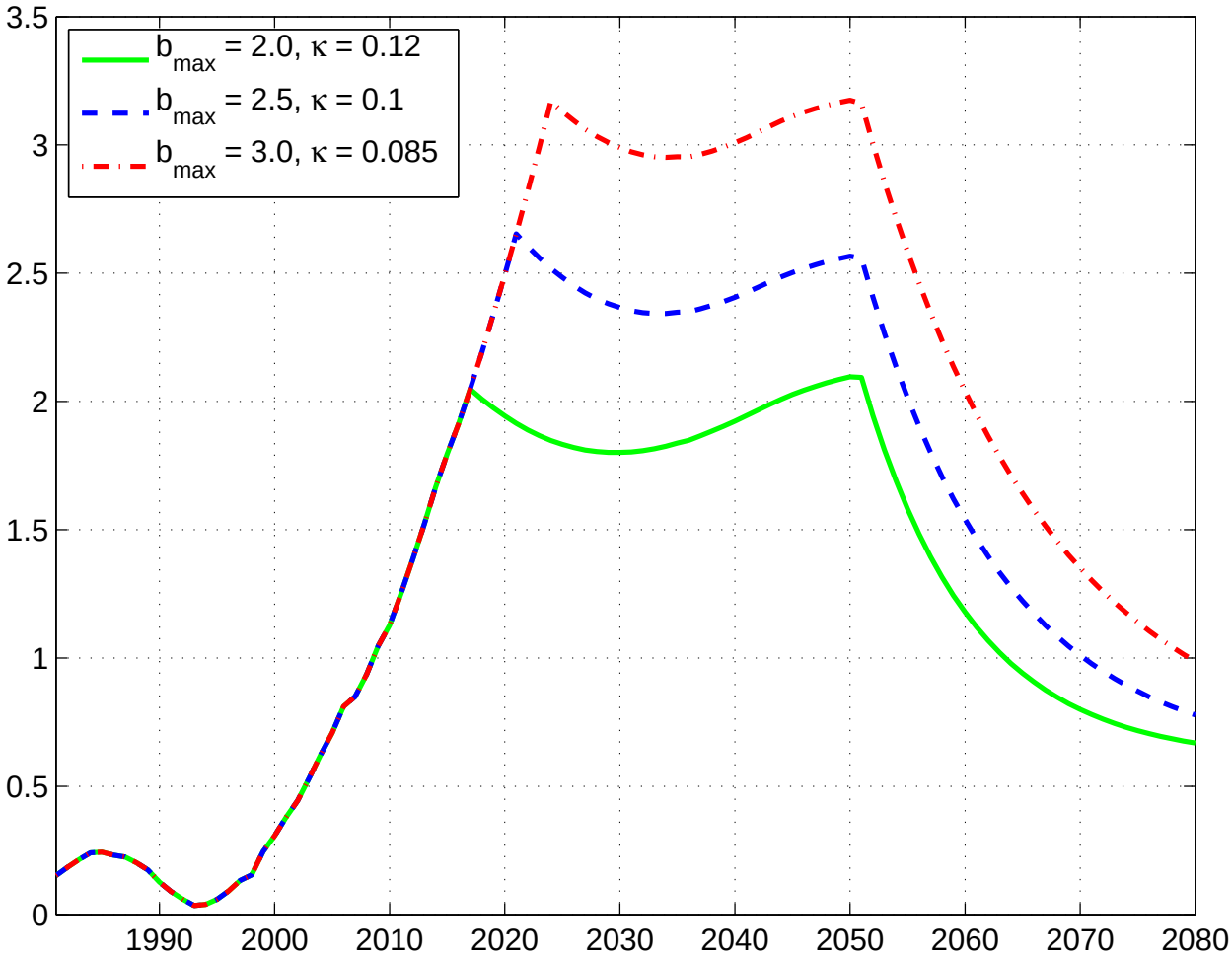


Figure : Bond to Output Ratio for Alternative Maximum Debt to GNP Ratios

Fiscal Sustainability

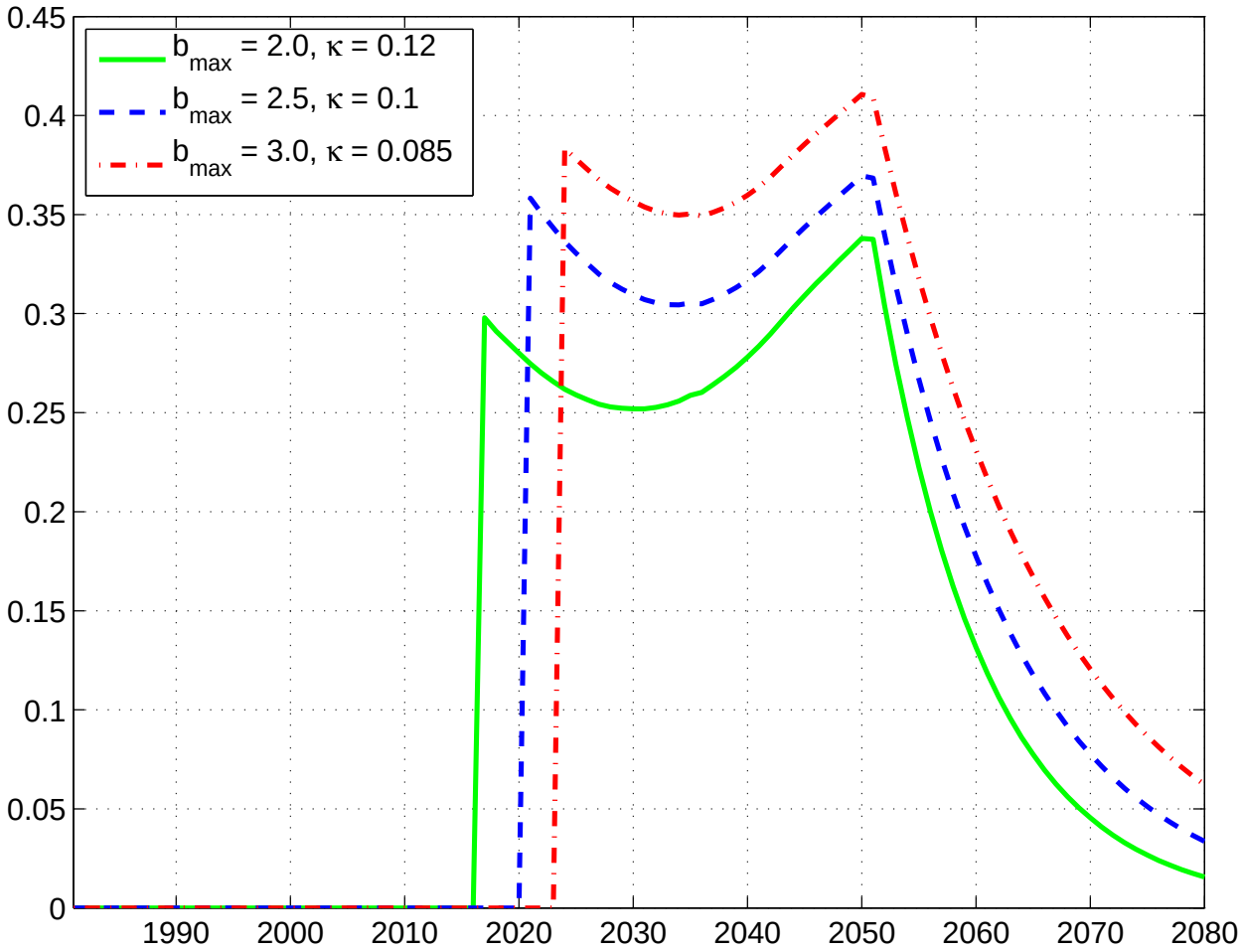


Figure : Revenue Requirement for Alternative Maximum Debt to GNP Ratios

Comparison of Benchmark with Data

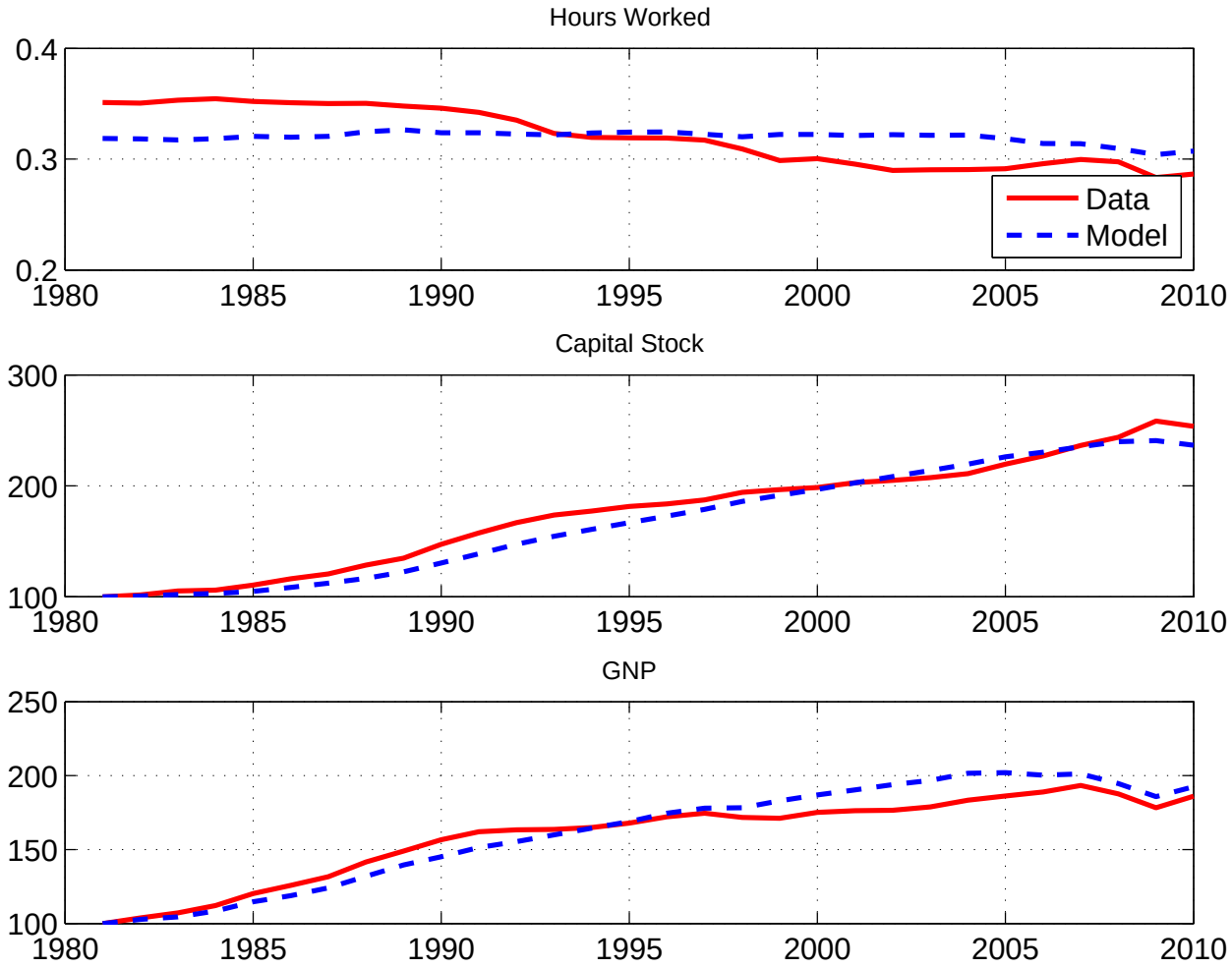


Figure : Labor, Capital, and Output

Comparison of Benchmark with Data

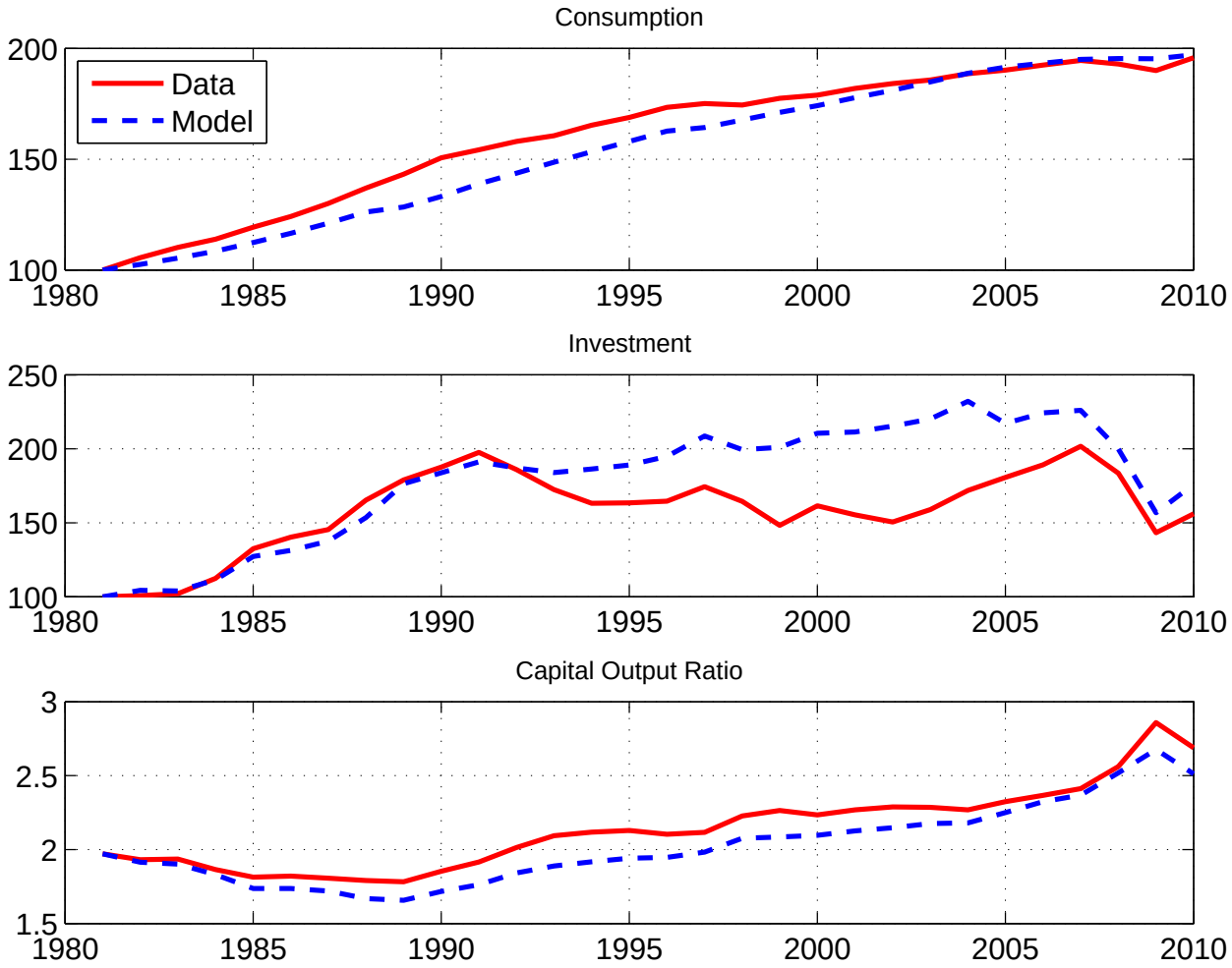


Figure : Consumption, Investment, and Capital-Output Ratio

Comparison of Benchmark with Data

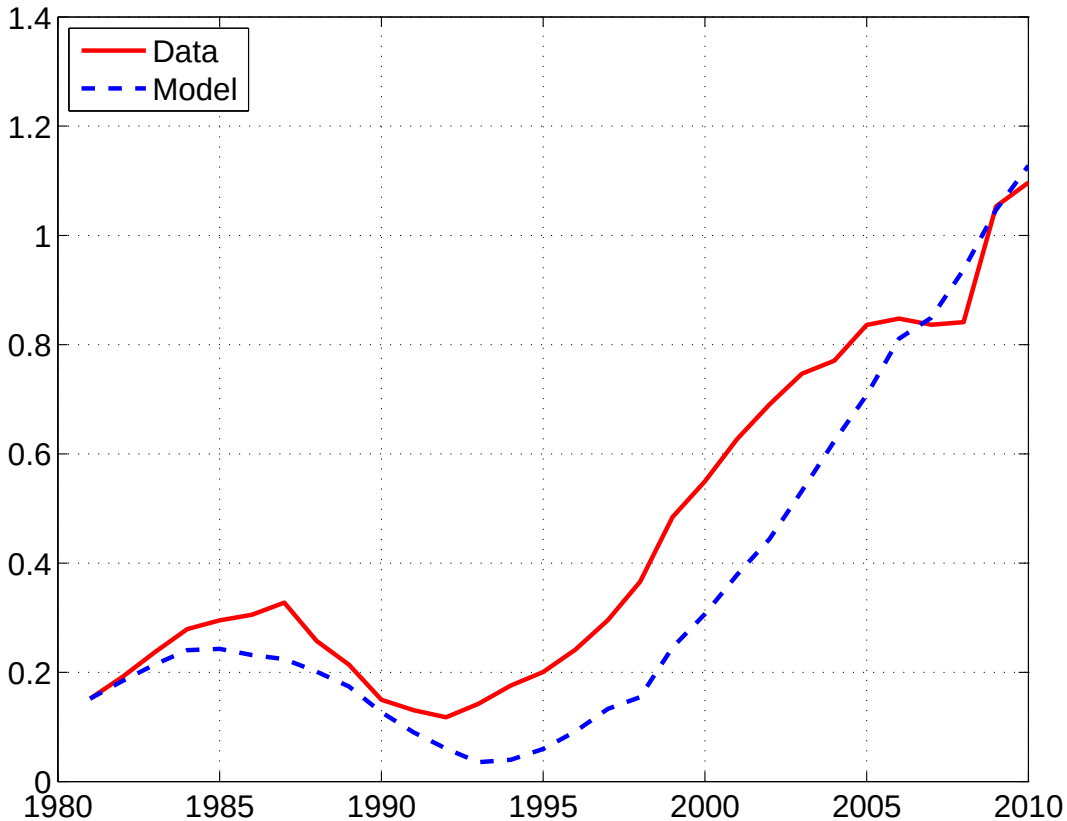


Figure : Bond to Output Ratio

Government Finance in Steady State
Labor Tax

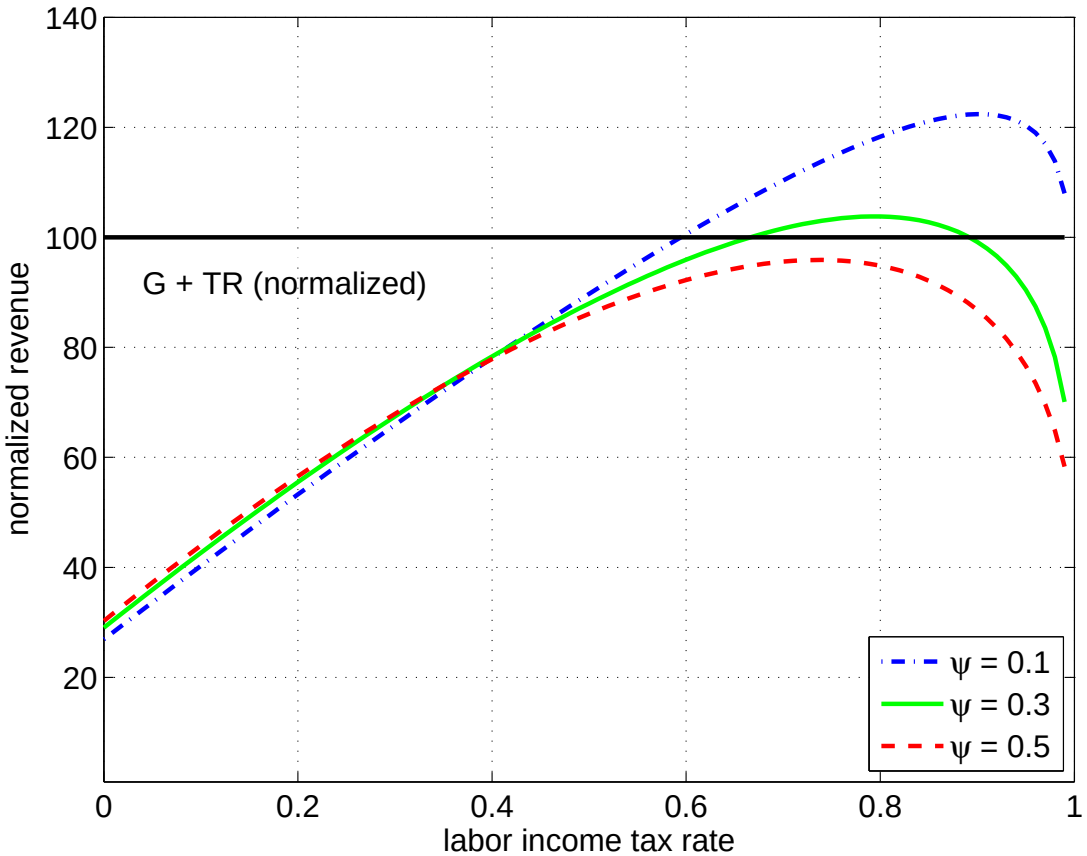


Figure : Labor Income Tax Laffer Curve

Government Finance in Steady State

Consumption Tax

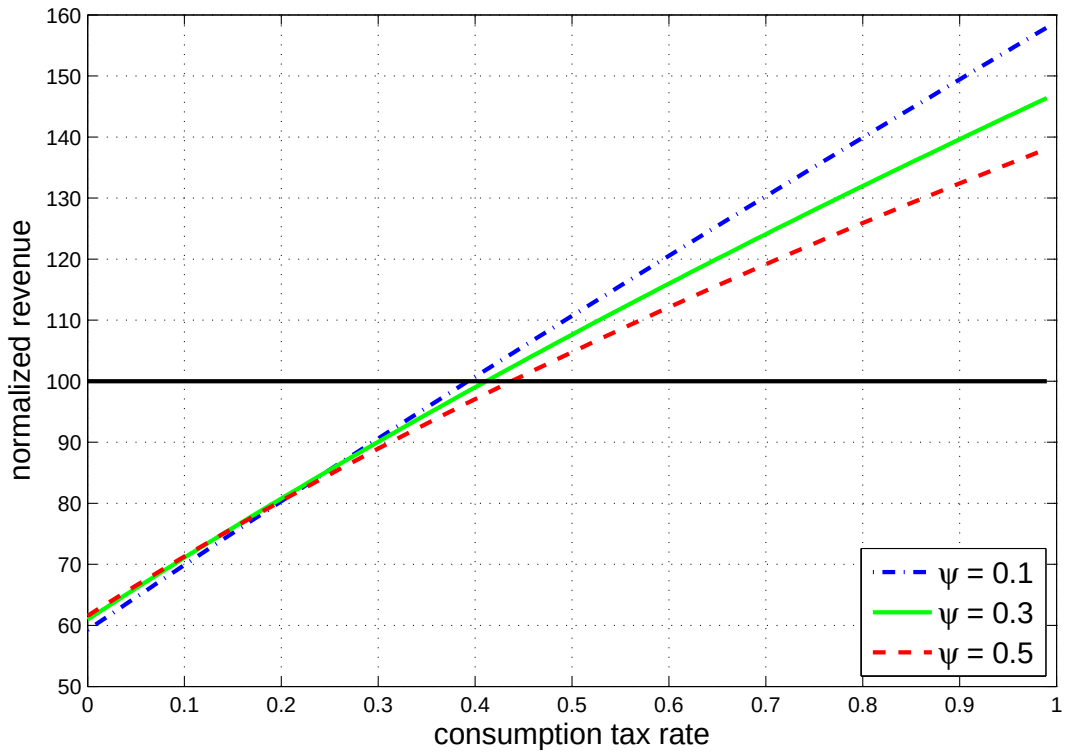


Figure : Consumption Tax Laffer Curve

Tax Wedge

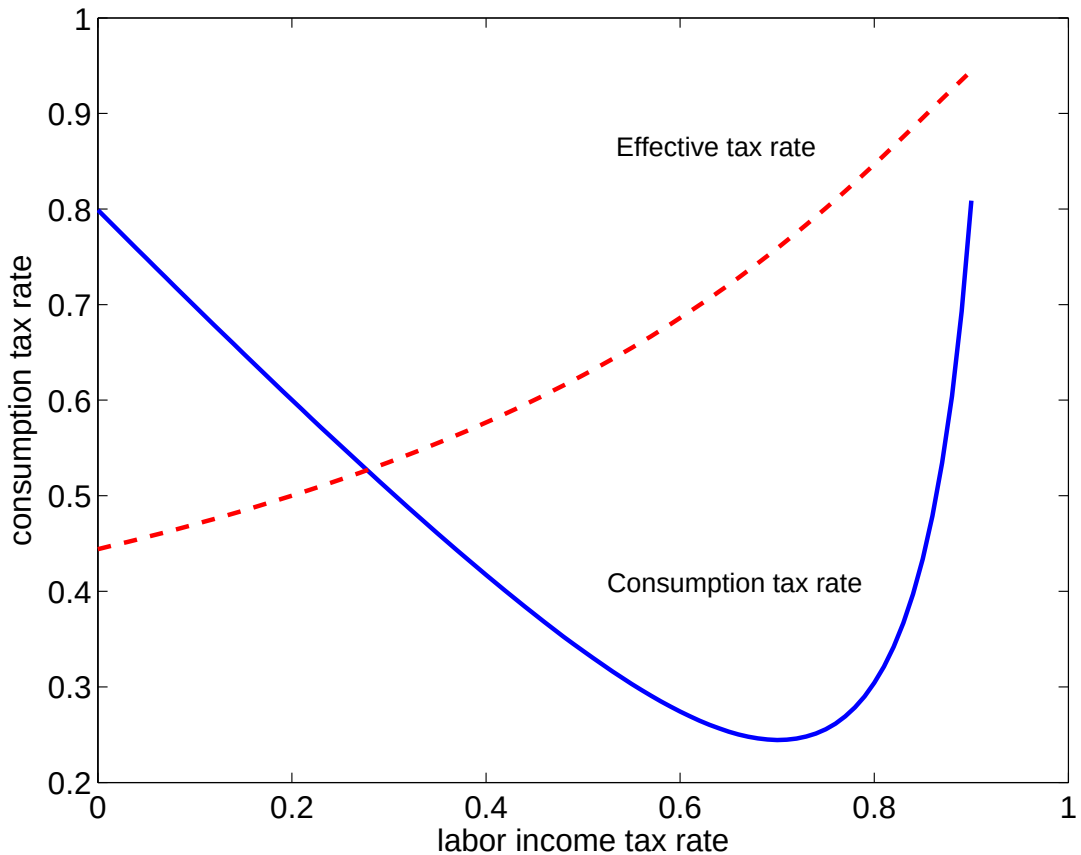
From first order condition for labor, can define

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

$$\Rightarrow \tau_t = \frac{\tau_{c,t} + \tau_{h,t}}{1 + \tau_{c,t}}$$

Government Finance in Steady State

Iso-Revenue Curve



Implementation of Tax Increases

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

where $x = c$ or h.

- π 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 τ_c only.
2. Raise τ_c and set $TR_t = TR_t^B - 0.08\,Y_t$.
3. Raise τ_h and set $\tau_{c,t} = \tau_{c,t}^B + 0.3$.
4. Raise τ_h and set $\tau_{c,t} = \tau_{c,t}^B + 0.3$ and $TR_t = TR_t^B - 0.08\,Y_t$.
5. Raise τ_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

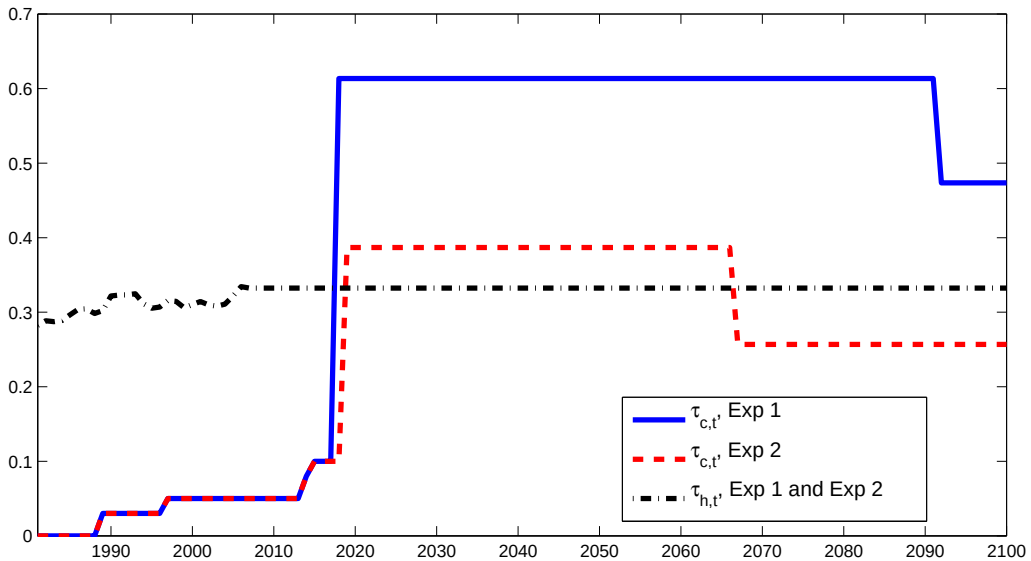


Figure : Consumption Tax Experiments

Increase Both Consumption and Labor Tax

Raise labor tax to retire debt, permanent increase in consumption tax so this is possible.

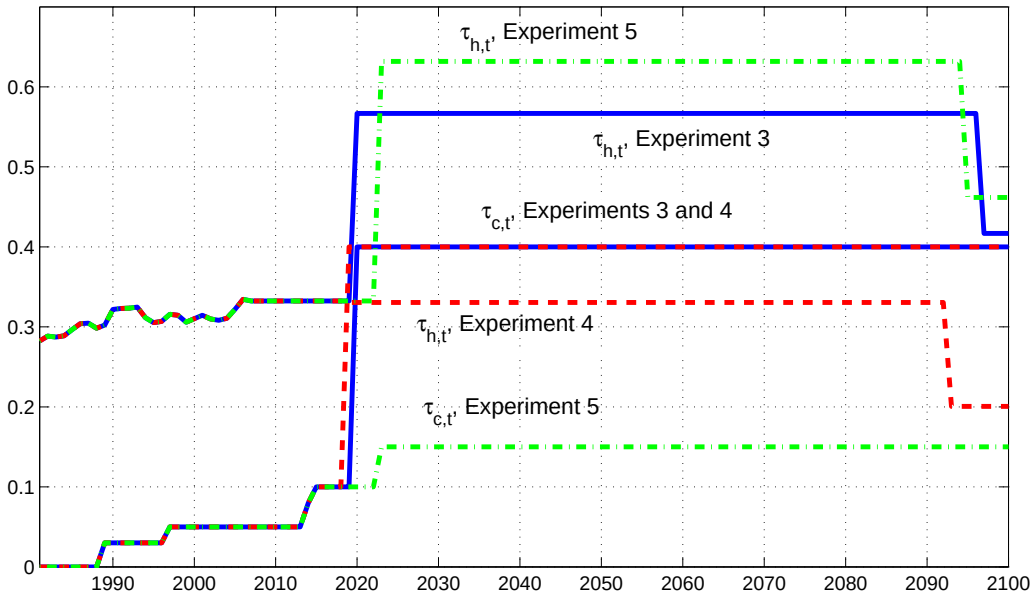


Figure : Labor Income Tax Rate

Transition Paths for Various Experiments

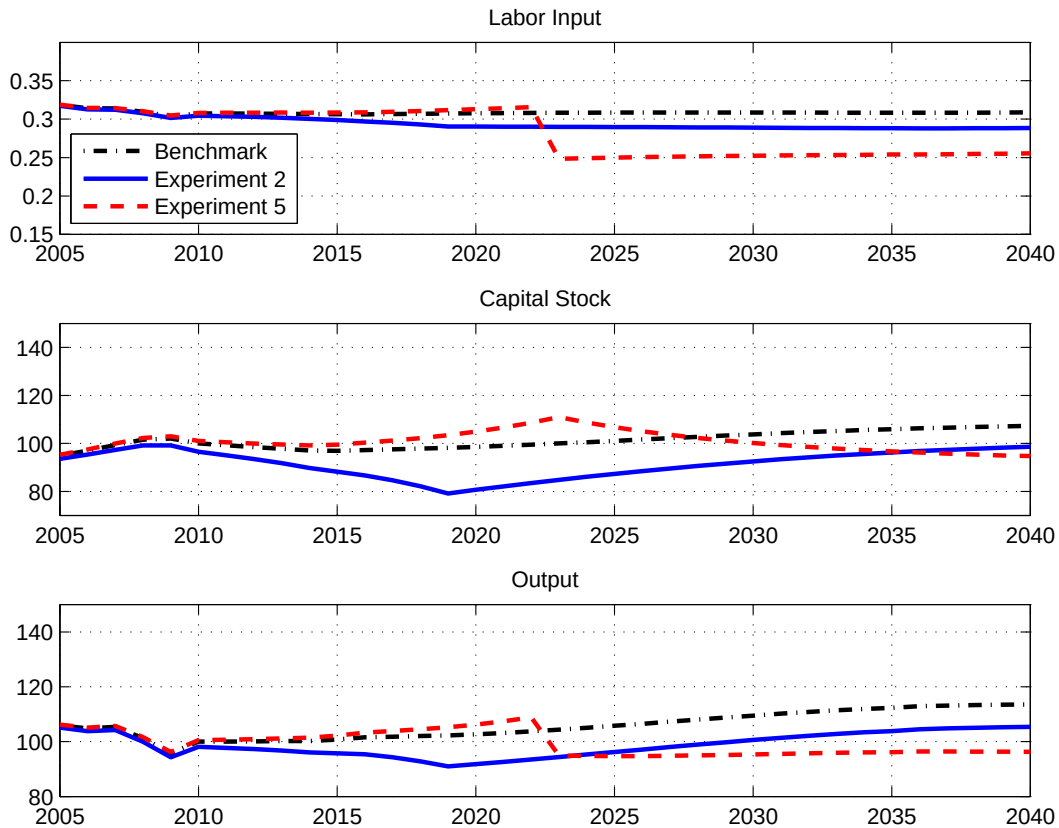


Figure : Labor, Capital, and Output

Transition Paths for Various Experiments

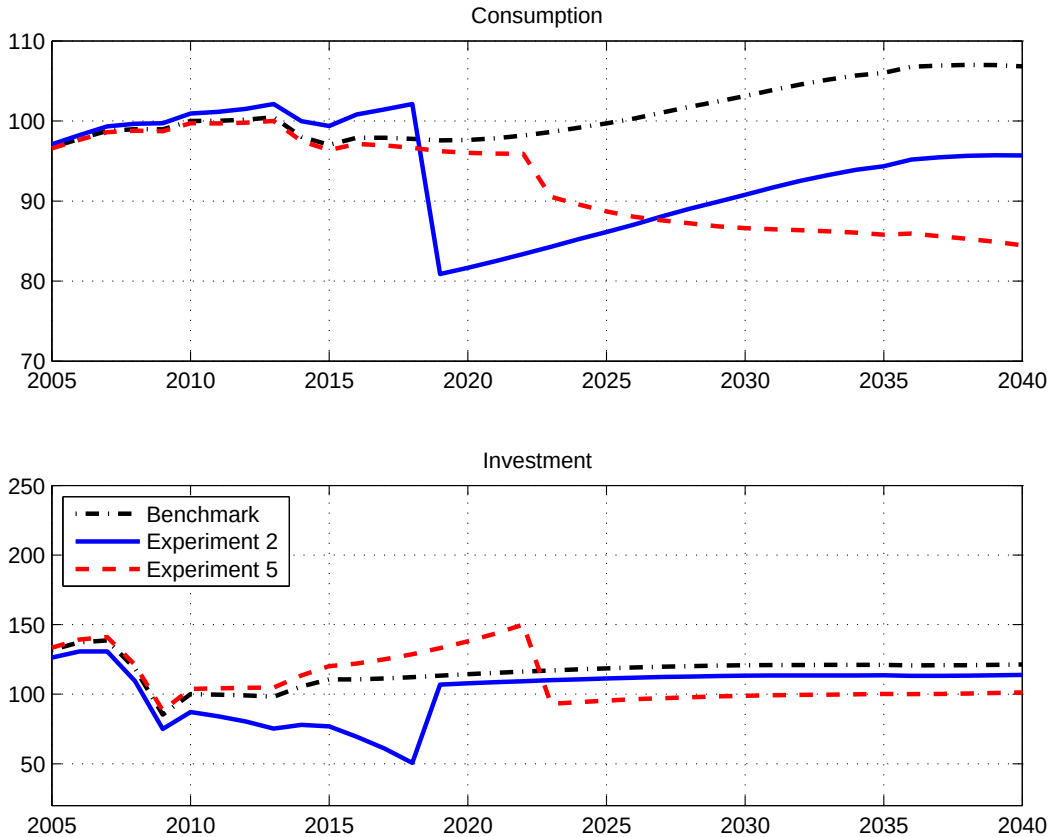


Figure : Consumption and Investment

Transition Paths for Various Experiments

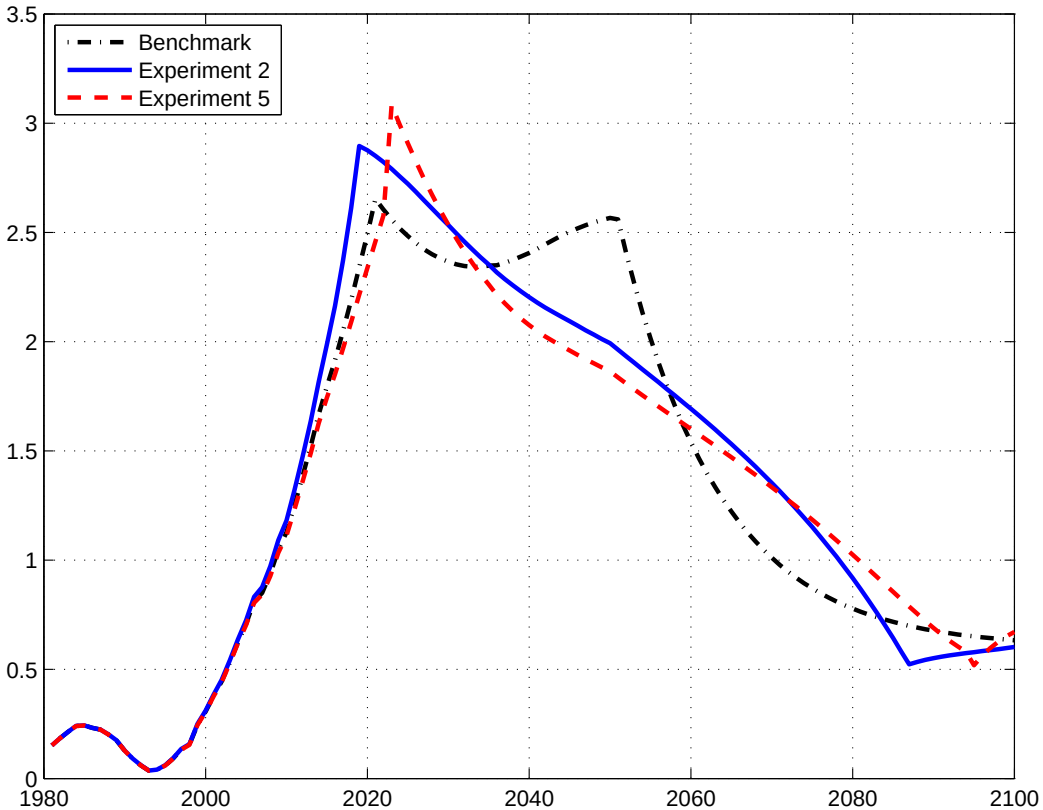


Figure : Debt to GNP Ratio

Effective Tax Distortion

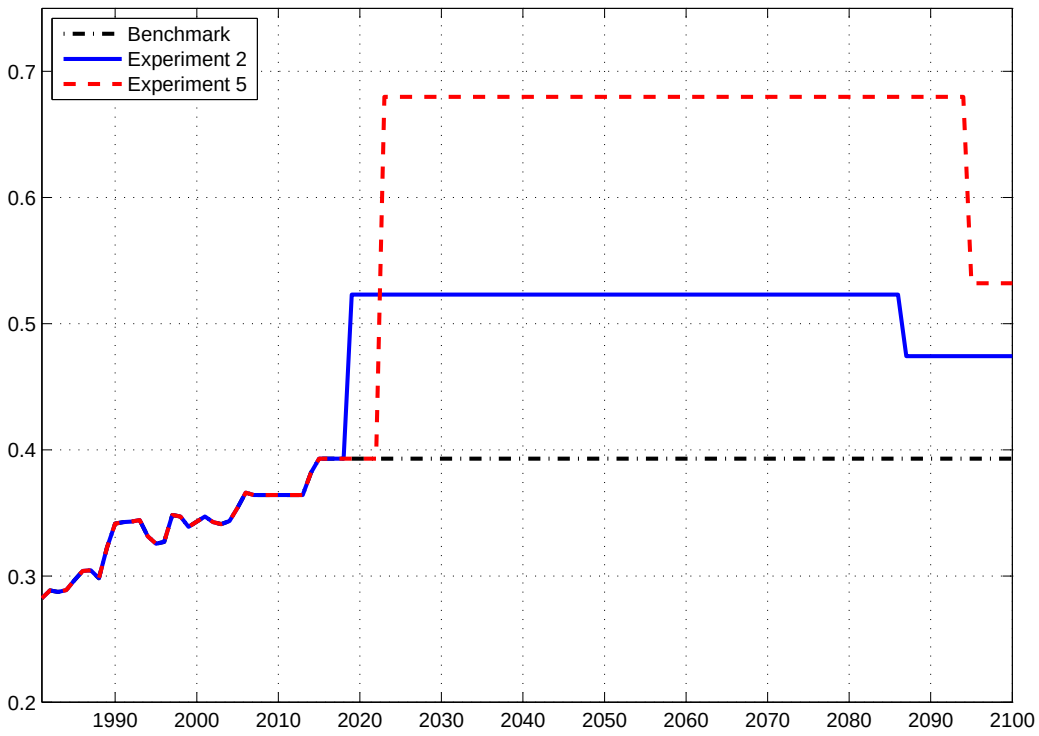


Figure : Effective Tax Rate

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.

Conclusion

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