Productivity and Fiscal Policy in Japan: Short-Term Forecasts from the Standard Growth Model

Selahattin İmrohoroğlu and Nao Sudo

Japan is facing severe fiscal challenges. The aging of the population is projected to raise total pension and health expenditures. There is already a huge debt to output ratio, which is the highest among the advanced economies. In this paper we ask, "If the consumption tax rate is raised to 15 percent, will it generate a primary surplus, and what factors are important in achieving a fiscal balance?" With the standard growth model's simulations as "back-of-the-envelope" calculations, the quantitative findings indicate the critical need to contain government expenditures. Even an annual growth rate of 3 percent in GDP over the next 20 years may be insufficient to produce consistent primary surpluses, combined with a new consumption tax rate of 15 percent, unless prudent expenditure policies are implemented.

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I. Introduction

Japan is facing significant demographic and fiscal challenges. As of 2010, the immediate economic problem is the economic slowdown that started in the second quarter of 2008 and continued in the first quarter of 2009, when real GDP recorded its largest drop since World War II. However, output recovered in 2009/Q2 and Q3, and the outlook was guardedly optimistic.

The "not-so-good-news" is the future implications for the ratio of government debt to GDP, which is already the highest among the OECD countries. In addition to concerns about the aging of the population and the fiscal problems associated with it, there is the issue of the need to bring the debt to GDP ratio down to levels closer to those of the other major developed countries. Japan now has the largest debt to GDP ratio among developed countries. A large part of this debt was accumulated when Japan responded to the "lost decade" of the 1990s by substantially increasing government purchases in the form of public works projects that were financed by new and large issues of debt. According to the Ministry of Finance, the gross debt of the Japanese government was projected at about 200 percent of GDP at the end of 2010. This ratio is more than twice that in other developed countries such as France, Canada, Germany, and the United States, as depicted in Figure 1.

Figure 1 Gross Debt to GDP Ratio

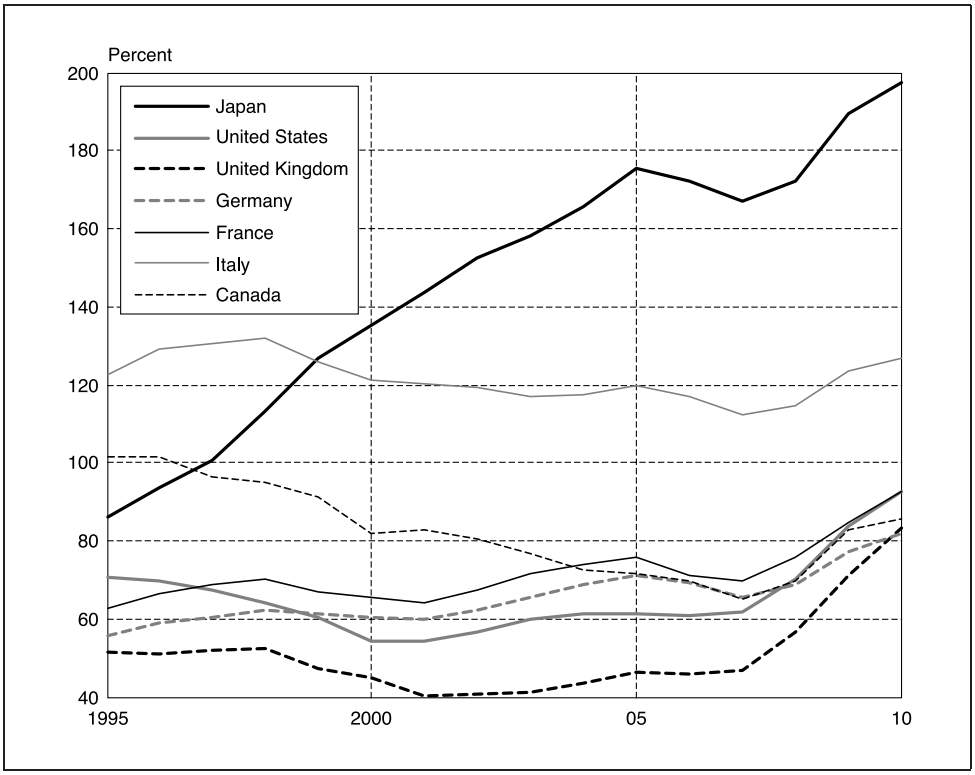
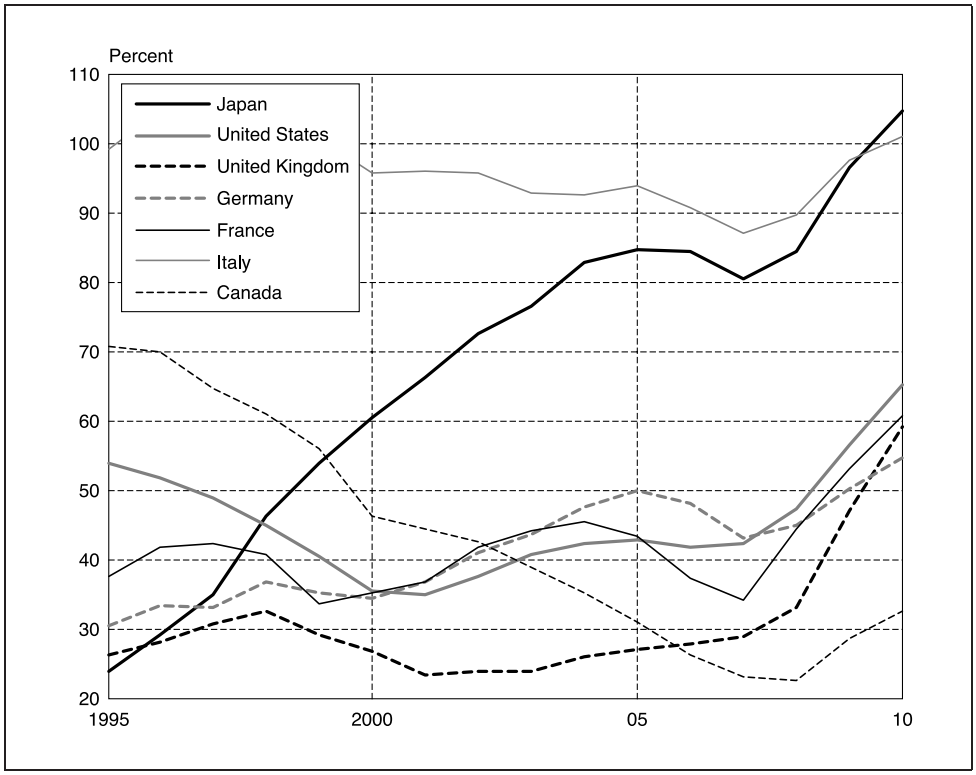


Figure 2 Net Debt to GDP Ratio



Japan's net debt to GDP ratio is also very large, about twice that of the developed countries mentioned above. Japan has overtaken Italy as the nation with the largest debt to output ratio on a net basis among the developed countries. Figure 2 shows the ratio of net government debt to GDP in a subset of OECD countries. The fiscal response to the lost decade has pushed this ratio from below 20 percent in the early 1990s to 104.6 percent projected for 2010.

In this paper, the standard growth theory is used to evaluate two counterfactual fiscal experiments that are designed to achieve a primary budget surplus in the near future, based on the data available in 2010. The consumption tax is raised from the current 5 percent value to 15 percent in two separate experiments. First, the tax is raised gradually, 2 percentage points per year, starting from 2010 and ending in 2014. Second, the consumption tax rate is raised in one step to 15 percent in 2010.[1]

The simple growth framework of this paper follows Hayashi and Prescott (2002), which has studied the factors behind the lost decade in Japan. A related paper is Chen, İmrohoroğlu, and İmrohoroğlu (2006), which explores the economic and demographic reasons behind the secular patterns of the Japanese saving rate. This approach

1. Our model focuses on the real economy where all of the variables including those related to the revenues and expenditures of general government are expressed in real terms.

generates model simulations that match actual data reasonably well and therefore provides a useful measuring device to evaluate government policy.[2]

The model is populated by a representative household that faces complete markets and maximizes the sum of discounted period utilities subject to its present value budget. A stand-in firm uses a constant returns to scale Cobb-Douglas production function to maximize its profits, producing equality between factor prices and their marginal productivities. There is a government that finances its exogenous stream of purchases, transfer payments, and interest on government debt by taxing factor incomes and consumption and issuing new debt. We calibrate the model to the Japanese national income accounts, start from given initial conditions in 1981, and calculate the equilibrium transition path of the Japanese economy toward a steady state in the far-distant future. We equip the representative household with perfect-foresight knowledge of exogenous variables in the model, such as total factor productivity (TFP) and population growth rates, depreciation rates, tax rates on factor incomes, and consumption.[3] Our benchmark transition policy is to maintain the consumption tax rate at 5 percent for a long time, our so-called "do-nothing" policy. In addition, we characterize the equilibrium response of the economy to two distinct ways of dealing with the short-term fiscal imbalance. The first counterfactual experiment allows for a gradual increase in the consumption tax rate from 5 percent to 15 percent in five years starting in 2010. A second policy is to raise the tax rate from 5 percent to 15 percent in one year in 2010.

The quantitative results indicate the importance of three factors in achieving a fiscal balance in the near future. First, and most important, the Japanese government's ability to contain government purchases of goods and services and transfer payments will be critical. If the projected increases in government expenditures related to the aging of the population are realized, then it is almost impossible for a primary surplus to occur without sharp increases in tax rates and fast economic growth. Second, the rate of growth of output will affect the tax base and therefore the outcome on the primary balance. The higher the growth rate of output, the less difficult it is to obtain a primary surplus. Finally, raising the consumption tax rate in one step, rather than a gradual approach, leads to a primary balance earlier than otherwise and makes the outcome a bit less dependent on the growth rate of output. We emphasize that the fiscal policy experiments are conducted in a general equilibrium model that takes into account the optimal response of the private sector to the tax increase and the related changes in the factor prices and their consequences on the government's budget.

There is a large body of literature on the fiscal challenges faced by Japan.[4] Most of this research tries to evaluate the effects of social security reform; some also study the role of government debt in the economy. Since there is no established theory of government debt, economists typically take the view that debt levels larger than what we have experienced in the past appear unsustainable. As a result, economic models

2. For other interesting applications of the standard growth model to international recessions, see Kehoe and Prescott (2002).
3. We conduct a sensitivity analysis that relaxes the assumption of perfect foresight in a particular way. Our results turn out to be robust. Other studies have tried stochastic simulations instead of ones with perfect foresight, and the quantitative findings were very similar.
4. For example, Enomoto and Iwamoto (2008) estimate that the economic slowdown during the lost decade raised the debt to GDP ratio by 26 percentage points.

are used to assess the impact on the economy of different levels of government debt, sometimes taking into account the transitional cost of reducing the debt to output ratio to "historical" levels. Ihori *et al.* (2006) and Kotlikoff (2006) present simulations using general equilibrium, overlapping-generations models to study the impact of aging and a large government debt on the Japanese economy. The focus of these papers is the long run, although they do calculate transitional paths. In contrast, our contribution is the use of the workhorse macro model as a simple way of producing "back-of-the-envelope" calculations with a short-run focus that might provide insights for fiscal policy in the short term.

The paper is organized as follows. Section II describes the Japanese fiscal conditions. Section III contains the model used in the paper. Measurement and calibration are discussed in Section IV. Numerical results are presented in Section V, and sensitivity analysis is carried out in Section VI. Concluding remarks are in Section VII.

II. Japanese Fiscal Conditions

According to the Ministry of Finance publication "Current Japanese Fiscal Conditions and Issues to Be Considered: 2008," successive Japanese governments have been working to restore the fiscal balance by reforming both expenditures and revenues. The roadmap and targets of fiscal consolidation have three stages:

- Phase I (fiscal 2001–06): Reforms by the Koizumi Cabinet.
- Phase II (fiscal 2007–early 2010s): Achievement of a primary surplus by 2011.
- Phase III (early 2010s–mid-2010s): Maintenance of a primary surplus and the start of reducing debt/GDP.

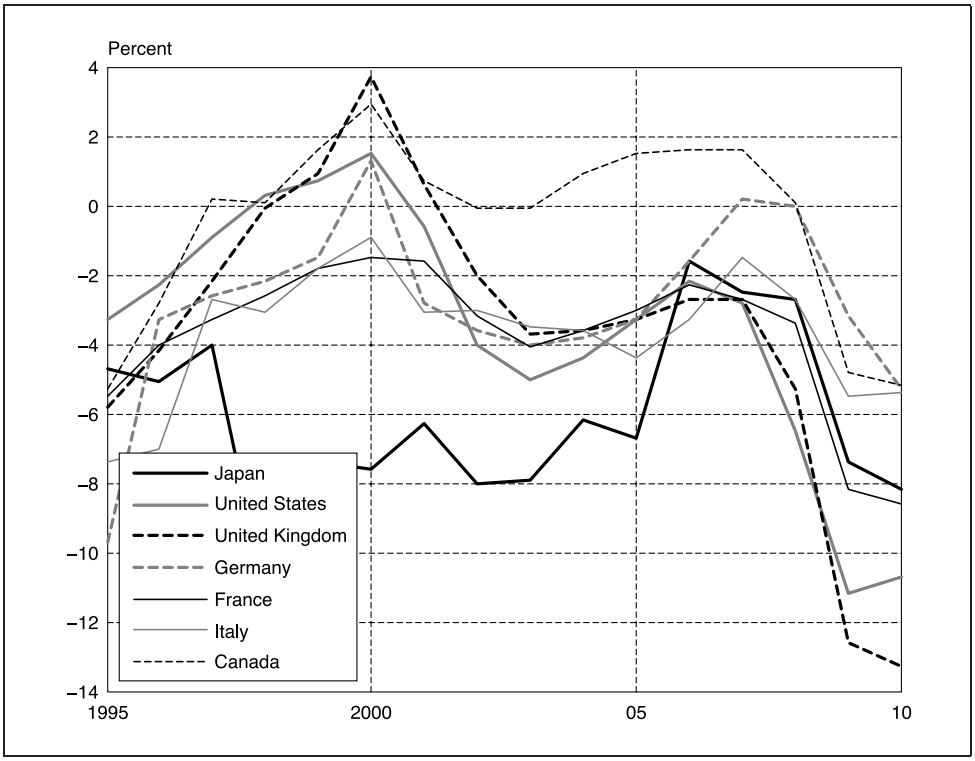
An international comparison of the recent budget deficits of Japan and other OECD countries is given in Figure 3. Over the last decade or so, Japan has run much larger budget deficits than other developed countries, mostly due to its aggressive fiscal expansions with the stated goal of stimulating the economy. In particular, Japanese fiscal authorities added massive debt in the period from 1995 to 2005 and added smaller amounts after 2005 until the recent financial crises and recession.

At the end of 2008, the government estimated that ¥16.5 trillion would be needed to achieve its target. Planned cuts in expenditures were between ¥11.4 trillion and ¥14.3 trillion. This left about ¥2.2 trillion to ¥5.1 trillion to be financed via an additional consumption tax. As of July 2010, there is a new fiscal authority in Japan, with a slightly different fiscal outlook. According to the highlights of the budget for 2010 published in December 2009, transfer payments (social security in particular) were expected to increase with a slight decline in government purchases. Our benchmark simulations will take into account these most recent fiscal plans and experiment with alternative fiscal paths as part of our sensitivity analysis.

III. The Standard Neoclassical Growth Model

The neoclassical growth model is the workhorse of macroeconomics. It has been quite useful in explaining how economies evolve dynamically in response to shocks and

Figure 3 Budget Balance to GDP Ratio



policy. For example, Hayashi and Prescott (2002) use the standard theory to provide some insight into the lost decade of Japan. They argue that the decline in the work-week in the 1990s and the slowdown in Japanese TFP have been responsible for the drawn-out stagnation of real output. Chen, İmrohoroğlu, and İmrohoroğlu (2006, 2007) and Braun, Ikeda, and Joines (2009) examine the factors responsible for the decline in the Japanese saving rate and argue that the secular decline in the TFP growth rate seems quantitatively important. More recently, Chen, İmrohoroğlu, and İmrohoroğlu (2009) analyze the secular decline in the U.S. current account balance and attribute it to the decline in the relative growth rates of TFP in the United States and its major trading partners.

This research suggests that the standard growth theory can serve as a valuable guide for government policy, as it seems to be a useful measuring device. In this class of models, economic agents take into account the environment in which they operate such as the demographic structure, production technology, the government's policy, and factor prices, and make informed choices regarding consumption, saving, and labor supply. When there is a change in government policy, they reoptimize and respond to the change in their environment in an optimal manner. After the benchmark model is characterized and its properties studied, this research conducts counterfactual policy experiments to provide some insight into the likely effects of different government policies.

A. The Household's Problem

The model economy is the standard growth theory under complete markets, and has been the workhorse of macroeconomics over the last three decades. A representative household with N_t working-age members at date t solves

$$\max \sum_{t=0}^{\infty} \beta^t N_t \log c_t$$

subject to

$$(1+\tau_{c,t})C_t + K_{t+1} \leq [1+(1-\tau_{k,t})(r_t-\delta_t)]K_t + (1-\tau_{h,t})w_t H_t + TR_t - N_t\tau_t + N_t\pi_t^p,$$

where $c_t = C_t/N_t$ is consumption per household member; $h_t = H_t/N_t$ is the fraction of hours worked per member of the household; β is the subjective discount factor; H_t is total hours worked by all working-age members of the household; $\tau_{h,t}$ and $\tau_{k,t}$ are tax rates on labor and capital income, respectively, at time t; $\tau_{c,t}$ is the consumption tax rate; τ_t is a per capita lump-sum indirect tax distinct from the consumption tax; w_t is the real wage; TR_t is aggregate government transfers; π_t^p is the per member primary balance; r_t is the rental rate of capital; and δ_t is the time-t depreciation rate.[5] Beginning of period t assets are denoted by K_t. The size of the household evolves over time exogenously at the rate $n_t = N_t/N_{t-1}$. It is assumed that the representative household receives the interest earnings on the government debt. In addition, markets are complete.

B. The Firm's Problem

There is a representative firm with access to a constant returns to scale Cobb-Douglas production function given by

$$Y_t = A_t K_t^{\theta} H_t^{1-\theta},$$

where θ is the income share of capital and A_t is TFP, which grows exogenously at the rate $g_t = A_t/A_{t-1}$. Aggregate capital stock follows the law of motion

$$K_{t+1} = (1-\delta_t)K_t + X_t, \tag{1}$$

where X_t is gross investment at period t, and δ_t is the rate of depreciation of capital at time t.

The stand-in firm maximizes its profits by choosing capital and labor. This produces the usual equilibrium conditions that equate factor prices to their marginal productivities.

C. Government Budget

There is a government that taxes consumption and income from labor and capital (net of depreciation) and uses the proceeds to finance exogenous streams of government

5. When we refer to economy-wide aggregate quantities, we will use uppercase letters.

purchases G_t and government transfer payments TR_t. The (per capita) budget balance π_t^b and primary balance π_t^p are defined implicitly as follows.

$$G_t + TR_t + I_t = \tau_{h,t} w_t H_t + \tau_{k,t}(r_t - \delta_t) K_t + \tau_{c,t} C_t + N_t \tau_t - N_t \pi_t^b, \quad (2)$$

$$G_t + TR_t = \tau_{h,t} w_t H_t + \tau_{k,t}(r_t - \delta_t) K_t + \tau_{c,t} C_t + N_t \tau_t - N_t \pi_t^p, \quad (3)$$

where I_t represents interest payments on government debt.[6]

D. Competitive Equilibrium

Given the government's fiscal policy $\{G_t, TR_t, I_t, \tau_{h,t}, \tau_{k,t}, \tau_{c,t}, \tau_t\}_{t=0}^{\infty}$, a competitive equilibrium consists of an allocation $\{C_t, X_t, H_t, K_{t+1}, Y_t\}_{t=0}^{\infty}$, a budget balance π_t^b, a primary balance π_t^p, and prices $\{w_t, r_t\}$ such that

- the allocation solves the household's problem,
- the allocation solves the firm's profit maximization problem with factor prices given by $w_t = (1-\theta) A_t K_t^{\theta} H_t^{-\theta}$, and $r_t = \theta A_t K_t^{\theta-1} H_t^{1-\theta}$,
- the government budget is satisfied, and
- the goods market clears: $C_t + X_t + G_t = Y_t$.

E. Equilibrium Conditions

The equilibrium conditions of the model can be combined and summarized in two equations below:

$$\frac{(1+\tau_{c,t+1}) C_{t+1}}{N_{t+1}} = \frac{(1+\tau_{c,t}) C_t}{N_t} \beta \times \{1 + (1 - \tau_{k,t+1})[\theta A_{t+1} K_{t+1}^{\theta-1} H_{t+1}^{1-\theta} - \delta_{t+1}]\}, \quad (4)$$

$$K_{t+1} = (1-\delta_t) K_t + A_t K_t^{\theta} H_t^{1-\theta} - C_t - G_t. \quad (5)$$

We consider a transition from given initial conditions to a balanced growth path at which per capita aggregate variables grow at the rate $g_t^{1/(1-\theta)}$. For an aggregate variable z_t, its detrended version is given by $\tilde{z}_t = z_t / [A_t^{1/(1-\theta)} N_t]$. Applying this change of variables to (4) and (5), we obtain equations

$$\tilde{c}_{t+1} = \frac{(1+\tau_{c,t})}{(1+\tau_{c,t+1})} \frac{\tilde{c}_t}{g_{t+1}^{\frac{1}{1-\theta}}} \beta \{1 + (1 - \tau_{k,t+1})[\theta x_{t+1}^{\theta-1} - \delta_{t+1}]\},$$

$$\tilde{k}_{t+1} = \frac{1}{g_{t+1}^{\frac{1}{1-\theta}} n_{t+1}} [(1-\delta_t) + (1-\psi_t) x_t^{\theta-1}] \tilde{k}_t - \tilde{c}_t,$$

6. In the current paper, we assume that government debt is held by domestic residents and interest payments are paid to them. Alternatively, we can assume that debt is held by foreigners and that the interest payments provide no utility to domestic residents. In this case, it is regarded as part of G_t. Our numerical results are not affected by the residency specification of government bondholders, since the interest payments on debt as a ratio of GNP are very small.

where ψ_t is the ratio of government purchases to output, G_t/Y_t, and x_t is the detrended capital-labor ratio, $(K_t/H_t)/A_t^{1/(1-\theta)}$.

Setting $\tilde{z}_t = \tilde{z}$ for all t, the steady state for the model can be calculated by solving two equations,

$$1 = \frac{1}{g^{\frac{1}{1-\theta}}}\beta\{1 + (1-\tilde{\tau}_k)[\theta x^{\theta-1} - \tilde{\delta}]\},$$

$$\tilde{k} = \frac{1}{g^{\frac{1}{1-\theta}}n}[(1-\tilde{\delta}) + (1-\tilde{\psi})x^{\theta-1}]\tilde{k} - \tilde{c},$$

which deliver the steady-state values of detrended capital and consumption where $\tilde{\delta}$, $\tilde{\tau}_h$, and $\tilde{\tau}_k$ are the steady-state depreciation rate, labor income tax rate, and capital income tax rate, respectively.

IV. Measurement and Calibration

In order for us to make predictions about the fiscal position of Japan in the near future, we want our model economy to generate aggregate behavior and fiscal outcomes that resemble their counterparts in the Japanese economy. First, we make adjustments to observed macroeconomic aggregates so that data accounts are in line with our model accounts. Second, we make adjustments to government accounts and bring them closer to what a government does in the standard growth model. Third, we calibrate our model economy to generate certain targets from the Japanese economy. Below, we will describe these calibration issues.

A. Adjustments to the System of National Accounts (SNA)

In standard growth theory, government consumption and investment are expensed. Therefore, consumption in the model is the sum of private consumption and government purchases of goods and services for both consumption and investment purposes. Following Hayashi and Prescott (2002), Japanese national accounts are updated to include annual data on macroeconomic indicators, including those in 2009.

B. Adjustment to Government Accounts

This subsection describes how the General Government Accounts are arranged so that the government accounts in the data are in line with those in the model. In particular, itemized government revenues will be sorted out so that they correspond to income from consumption and factor income taxation in the model. In addition, government spending items will be categorized. The aim is to have primary and budget balances in the data and model align conceptually. The ultimate goal of the paper is to quantify how close the standard growth theory comes in generating observed budget balance figures and to use the model to deliver short-run predictions on both the government accounts and national accounts.

1. Consumption tax revenue
Consumption tax revenue in the model is given by

$$\tau_{c,t} C_t. \tag{6}$$

Consumption tax revenue in the Japanese data corresponds to

value-added taxes (VAT). (7)

2. Income tax revenue
Factor income tax revenue in the model is given by

$$\tau_{h,t}(1-\theta) Y_t + \tau_{k,t}(\theta Y_t - \delta_t K_t). \tag{8}$$

In the data, this corresponds to the sum of four items:

$$\begin{pmatrix} \text{direct tax on nonfinancials, direct tax on financials,} \\ \text{direct tax on households, social security tax (gross)} \end{pmatrix}. \tag{9}$$

3. Budget balance
As we saw above, budget balance in the model is given by

$$\tau_{c,t} C_t + \tau_{h,t}(1-\theta) Y_t + \tau_{k,t}(\theta Y_t - \delta_t K_t) + N_t \tau_t - TR_t - G_t - I_t.$$

In Sections V and VI, primary balance figures compare "(6)+(8)+$N_t\tau_t - TR_t - G_t$" (model) and "(7) + (9) + $N_t\tau_t - TR_t - G_t$" (data), where variables TR_t and G_t are the series constructed from the data, according to the methodology provided below.

- Indirect tax revenue other than consumption tax, $N_t\tau_t$, is calculated as the sum of the following items:

$$\begin{pmatrix} + \text{ Import duties} \\ + \text{ Others} \\ + \text{ Other taxes on production} \\ - \text{ Subsidies, payable} \\ - \text{ Capital transfers, payable} \\ + \text{ Capital transfers, receivable} \end{pmatrix}.$$

- Transfer payments, TR_t, are calculated as the sum of the following items:

$$\begin{pmatrix} + \text{ Social benefits other than social transfers in kind, payable} \\ + \text{ Other current transfers, payable} \\ - \text{ Other current transfers, receivable} \end{pmatrix}.$$

- Interest payments on government debt, I_t, are calculated as the sum of the following items:

$$(\text{Property income, payable} - \text{Property income, receivable}).$$

- Government purchases of goods and services, G_t, are calculated as the sum of the following items:[7]

$$\begin{pmatrix} + \text{ Final consumption expenditure} \\ + \text{ Gross fixed capital formation} \\ - \text{ Consumption of fixed capital} \end{pmatrix}.$$

C. Calibration of the Model

The goal of calibrating the model is to place the economic agents in an environment to produce economic behavior similar to that of the Japanese economy. The starting point for the analysis is 1981, the first year when national accounts are reported using a consistent set of definitions. The last period for which we have data for some of the variables is 2008. Therefore, the model will take observed inputs as given for the 1981–2008 period, and some values for 2009, and will make assumptions about the values of these exogenous inputs for 2009 and beyond. A steady state is assumed to be reached far into the future so that we have a two-point boundary problem, starting with given initial conditions in 1981 and ending at a steady state far into the future. Following Hayashi and Prescott (2002), we use a shooting algorithm to calculate an equilibrium transition path that connects these two boundary points. Since the steady state is reached far into the future, our assumptions about that steady state will have minimal effect on the immediate future along the transition path.

The following two subsections will present the calibration choices in detail. First, there are two parameters that are constant throughout the analysis. Second, there are exogenous inputs for which we have direct observations. And, third, assumptions need to be made for the values of these exogenous inputs for 2009 and beyond.

1. Constant parameters and steady-state calibration

Table 1 shows the calibrated values of these and other parameters in the steady state. The two parameters θ and β are invariant throughout our analysis. Following Hayashi and Prescott (2002), we use the sample average for the income share of capital θ in GNP from 1981 to 2008. The steady-state capital output ratio target is 2.0, which requires us to take a value of 0.97 for β. For δ, we also follow Hayashi and Prescott (2002) and obtain a value of 0.08. We use a TFP growth rate of 2 percent and population growth rate of 0 percent in the steady state, which is assumed to be reached far into the future and therefore does not affect our short-term predictions. These choices are summarized below.

7. In our model, the government purchase of goods and services does not contain "changes in inventories" and "purchases of land, net" that are included in the SNA. In the simulation, we add the actual values of these two series to both the model and data so that budget balance and primary balance are consistent with those based on the SNA.

Table 1 Calibration in the Steady State

β	0.97	Subjective discount factor
θ	0.377	Output share of capital
δ	0.08	Depreciation rate
$g-1$	0.02	TFP growth rate
$n-1$	0.0	Population growth rate
τ_k	0.398	Capital income tax rate
τ_h	0.298	Labor income tax rate
G/Y	0.25	Ratio of government purchases to GNP

Note: The parameters for fiscal policy for the steady state are chosen to equal their recent sample averages.

2. Inputs for 1981–2008 and beyond

We start from given initial conditions in 1981 for two reasons. First, starting from an earlier year such as 1960 yields similar results for the period in which we are interested. Second and more important, national accounts are available in a consistent manner only from 1981. From 1981 through 2008, we use the observed values for the following exogenous variables:

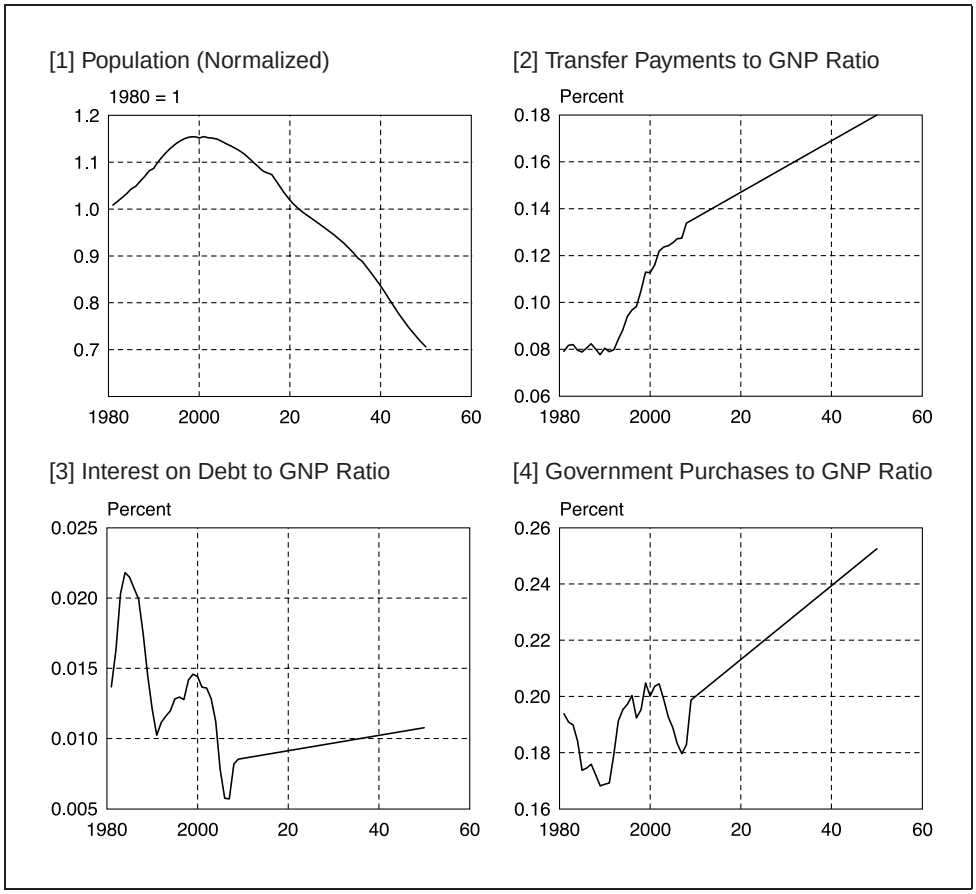
$$\{G_t/Y_t, TR_t/Y_t, I_t/Y_t, \tau_{h,t}, \tau_{k,t}, \tau_{c,t}, \tau_t, \delta_t, g_t, N_t, n_t, H_t\}_{t=1981}^{2008}.$$

The main reason our data stop with 2008 is the lack of data on the government's budget and the tax rates. For 2009, we can use actual data for the growth rates of TFP and population, the share of government purchases in GNP, total hours worked, real GNP, real consumption expenditures, and real investment expenditures. A detailed list of assumptions for various exogenous variables is given below.

- $\{G_t/Y_t, TR_t/Y_t\}_{t=1981}^{2008}$: Government purchases of goods and services and transfer payments, relative to GNP, are taken from the Japanese government and national accounts as described previously. The data on G_t/Y_t and TR_t/Y_t for 2009 are approximated from the publicly available but preliminary data.[8] For G_t/Y_t in 2009 and beyond, we set different time paths for each component of G_t, depending on its characteristics. The ratios of "gross fixed capital formation," "individual consumption expenditure," and "transfers of individual non-market goods and services" to GNP are assumed to linearly increase to their respective sample averages from 1999 to 2008 in 2050 and to remain constant at these 2050 levels forever. "Social transfers in kind, payable" is assumed to linearly converge to 12 percent of GNP in 2050, following the projections of Fukawa and Sato (2009), and to stay constant thereafter. Note that these expenditures are mainly for national health insurance, which is age-independent, plus long-term care for the elderly. As a result, G_t/Y_t is assumed to converge from 20 percent in 2009 to 25 percent by 2050. TR_t/Y_t is assumed to linearly converge from 13.5 percent in 2009 to 18 percent

8. To construct G_t for 2009, we extrapolate "gross fixed capital formation" by the growth rate of "public investment" from 2008 to 2009. We assume that "consumption of fixed capital" of 2009 equals that of 2008. We then add the two extended series to "final consumption expenditure" of 2009.

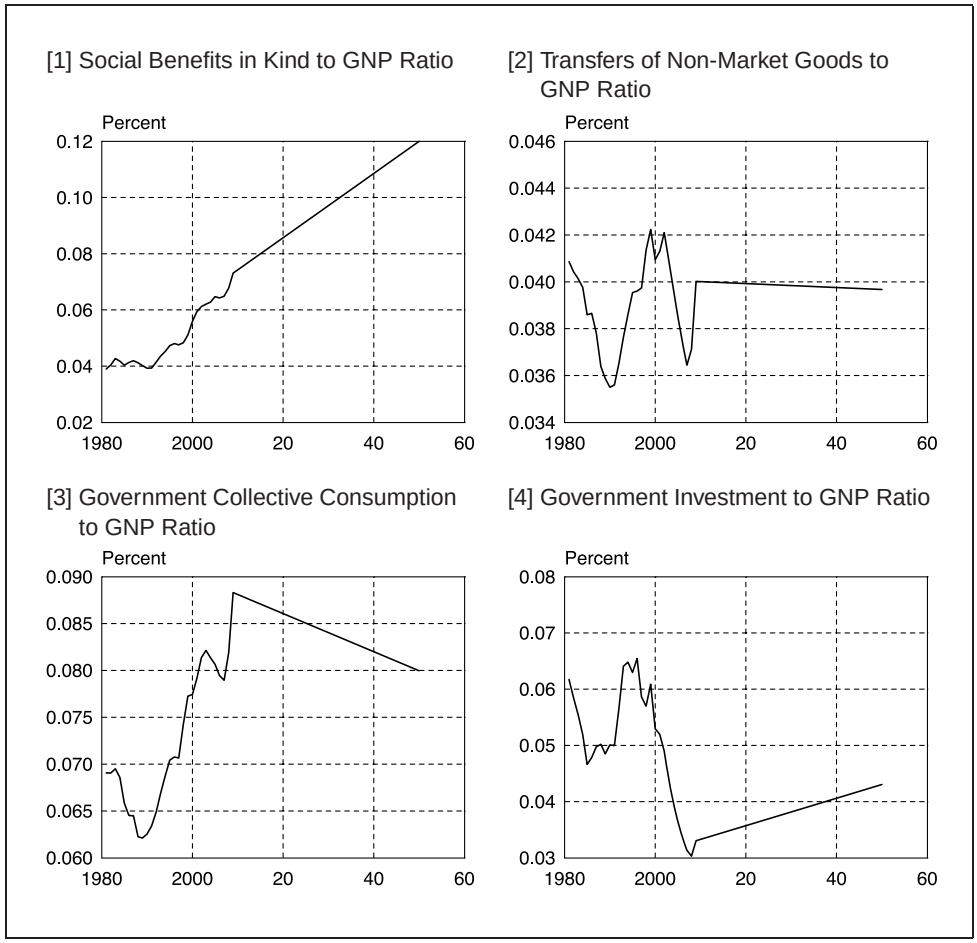
Figure 4 Population, Transfer Payments, Interest on Debt, and Government Purchases



in 2050, where we again rely on the estimates of Fukawa and Sato (2009). Note that the increase in the ratio of transfer payments to GNP represents the expected increase in total pension payments relative to the size of the economy. We assume that both items of government expenditures to GNP ratios stay constant after 2050. These projections introduce the fiscal pressures due to the expected aging of the Japanese population into our simple growth model. In Section VI.B, a sensitivity analysis will allow alternative paths for both purchases and transfer payments. In particular, we will explore the effects of "prudent" and "imprudent" policies that deviate ± 3 percentage points from the above benchmark ratios of 18 percent and 25 percent (for 2050) for TR/Y and G/Y, respectively. Figures 4 and 5 describe the benchmark paths of government expenditures, including the assumptions about their out-of-sample values.

- $\{\delta_t, g_t, N_t, H_t\}_{t=1981}^{2008}$: For the last three exogenous variables, 2009 values are available and used in the simulations. For the rate of depreciation of capital, δ_t, we set it equal to the value in 2008 for 2009 and thereafter. We extend N_t from 2010 to 2050 based on the medium-fertility and medium-mortality population

Figure 5 Assumptions on Sub-Categories of Government Expenditures



projections made by the National Institute of Population and Social Security Research, and assume that the population remains unchanged after 2050. We set H_t equal to the average from 1999 to 2009 for 2010 and thereafter. Our TFP is calculated as $A_t = Y_t / K_t^{\theta}(H_t)^{1-\theta}$. The growth rate of TFP, $g_t = A_t / A_{t-1}$, is a key exogenous variable that influences the growth of the tax base and therefore the size of the additional consumption tax needed to attain a primary surplus. The benchmark simulation assumes that the growth rate of TFP is 1 percent for each year between 2010 and 2028, and that it then rises to 2 percent and stays at this steady-state value forever. Since this paper focuses on the impact of fiscal policy on the Japanese macroeconomy in the short term, this assumption about the steady-state growth rate will have little quantitative effect on the model's predictions for the next 10 years. However, our assumptions on the growth rate of TFP from 2010 through 2028 may have some implications on the size of the tax base. Therefore we will also report the results of fiscal policies under two alternative assumptions on the growth rate of TFP. In the "pessimistic" case, the growth rate of TFP is zero

Table 2 TFP Growth Rates for 2010 and After

$g_t - 1$	TFP growth rate	0 percent for $2010 \leq t \leq 2028$	Pessimistic
		1 percent for $2010 \leq t \leq 2028$	Benchmark
		2 percent for $2010 \leq t \leq 2028$	Optimistic

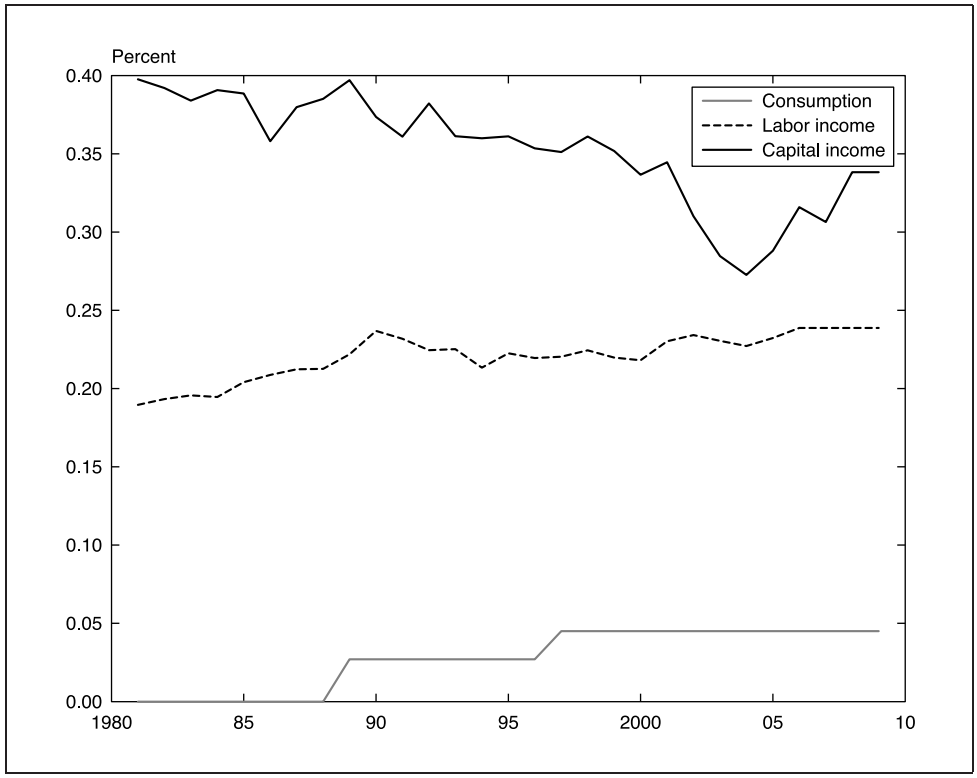
for the next 20 years. In the "optimistic" case, TFP grows at 2 percent annually. In both cases, the TFP growth rate takes on its long-run value of 2 percent in 2029 and beyond. Note that our growth rate assumptions are on the conservative side. In Section VI.B, we will consider the quantitative effects of a 3 percent rate of growth of TFP. Table 2 summarizes the assumptions on TFP growth rates.

- $\{\tau_{h,t}, \tau_{k,t}\}_{t=1981}^{2006}$: The labor income tax rate series is an updated version of that calculated by Mendoza, Razin, and Tesar (1995). They use national accounts and government revenue statistics for large industrial countries to compute annual time series of effective tax rates on factor incomes. The last year for which this tax dataset is updated is 2006, and we assume that $\tau_{h,2006} = 0.298$ for all years after 2006. The capital income tax rate is constructed according to the methodology in Hayashi and Prescott (2002). The last year for which we can construct this tax rate is 2008, and we assume that $\tau_{k,2008} = 0.398$ remains unchanged thereafter. This way, we can trace any changes in the model's accounts to our assumptions on the consumption tax rate, government expenditures, and TFP growth rates.
- $\{\tau_{c,t}\}_{t=1981}^{2008}$: The consumption tax in the model is assumed to rise from zero to 3 percent in 1989, and to 5 percent in 1997. In the data, there are taxes that are typically classified as consumption taxes, such as import and excise taxes that existed before 1989. In the model and data, we classify these as non-consumption (lump-sum) taxes so that we can concentrate on the more recent and targeted consumption taxes. In the steady state, we assume that the consumption tax rate is 15 percent unless a "do-nothing policy" is employed and 5 percent if a "do-nothing" policy is maintained. Since the steady state is reached in the far-distant future, this assumption has no quantitative impact on our predictions in the short run.

These three tax rates are displayed in Figure 6.

Figure 6 indicates a secular decrease in the tax on capital income (with a recent increase) and a slight and gradual increase in the labor income tax rate. The consumption tax rate follows a step function described above. Note that some categories of entities and goods may be exempt from taxes. Since the tax rates faced by the representative agent in the model are calculated from different sources, they will not produce model accounts that approximate the observed government accounts. As a result, an adjustment is necessary so that the tax revenues in the model and those in the data are reasonably aligned. For each time period t, we multiply the tax rate on consumption by a correction factor of 0.9, and the tax rates on labor and capital income are multiplied by constants 0.8 and 0.85, respectively. Note that this is only a level adjustment and aims to align the government accounts in the model and the data.

Figure 6 Tax Rates



V. Quantitative Findings

This section presents the main numerical results. First, the simulations of the benchmark model under the assumption of continued fiscal policy of 5 percent consumption tax are displayed, and then two counterfactual experiments are conducted that target a positive primary balance in the budget.

A. Benchmark Results

Figure 7 displays consumption, investment, output, and the capital-output ratio in the data and in the benchmark model, where the consumption tax is assumed to remain at 5 percent for a long time until the economy reaches a steady state, when the tax becomes 15 percent.

Despite its simplicity, the standard growth model captures the salient movements in the national accounts, as Figure 7 indicates. The lower-frequency movements in the model fit very well, consistent with the findings of Chen, İmrohoroğlu, and İmrohoroğlu (2006). Note that the calibrated model uses labor and capital income tax rates that are calculated using slightly different methodologies, and despite this difficulty the model performs very well in generating macroeconomic aggregates that approximate their data counterparts. The discrepancy between the model and the data is largest over the last few years, especially in investment and output, and therefore the capital-output ratio.

Figure 7 Benchmark Model and National Accounts

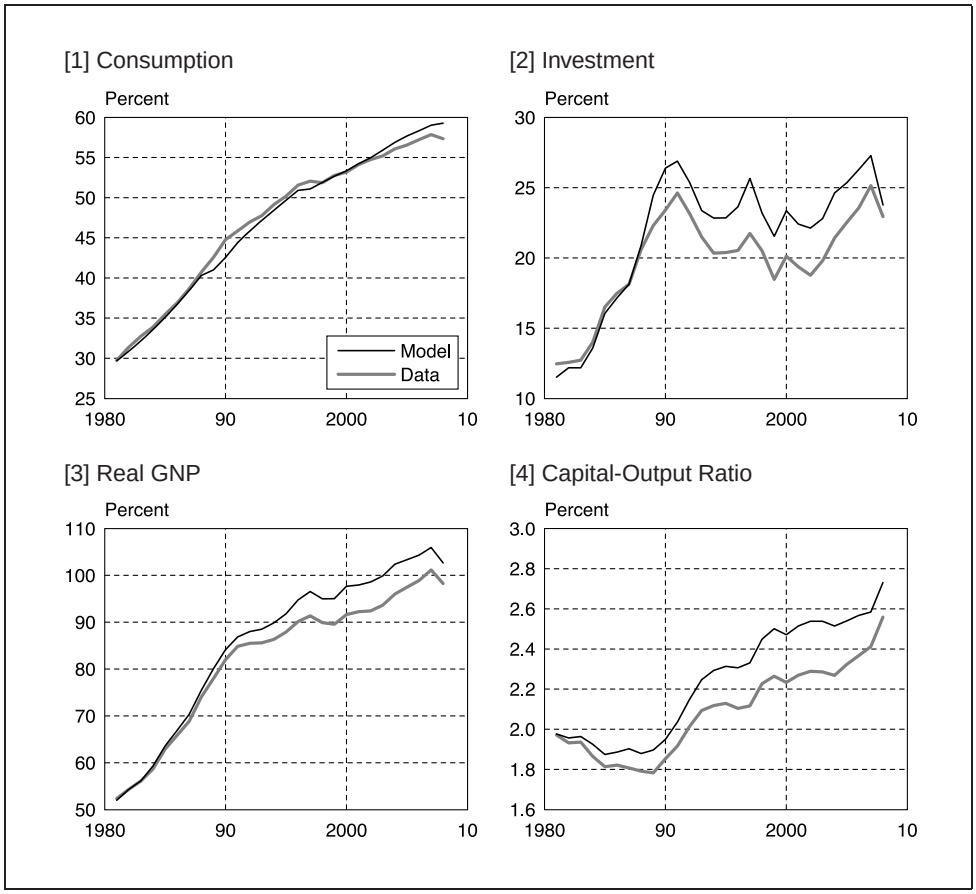
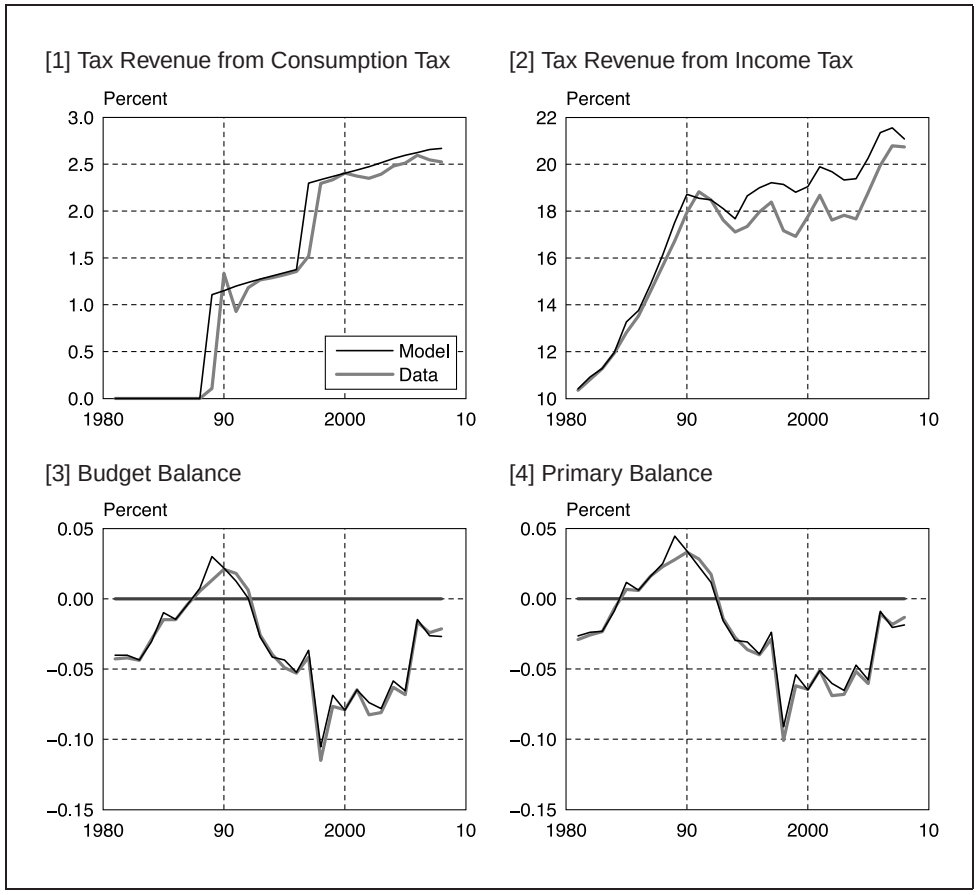


Figure 8 presents the government accounts in the model and the data. Here, the fit of the model and data accounts for government balances is quite remarkable. Over the entire "sample" period of 1981–2008, the model economy seems to generate economic behavior that delivers a primary balance very close to that in the data. In other words, our simple growth model generates reasonable observations on government accounts, and therefore it can provide some guidance to policy choices faced by the Japanese fiscal authority.

B. Fiscal Policy Experiments

As of the middle of 2008, the goal of the Ministry of Finance was to achieve a positive primary balance by 2011. Unfortunately, the recent downturn in economic activity has rendered the original goals very difficult to attain. This subsection describes two counterfactual experiments that aim to produce a positive primary balance in the near future. The first counterfactual experiment assumes that the consumption tax rate is raised from 5 percent by 2 percentage points each year starting in 2010,

Figure 8 Benchmark Model and Government Accounts



until it reaches 15 percent in 2014.[9] In the second experiment, the consumption tax is raised in one step to 15 percent in 2010. Both experiments are conducted as part of perfect-foresight equilibria, and the (eventual) new level of the consumption tax rate is maintained forever.

The previous section on calibration summarized our assumptions on fiscal variables for 2009 and beyond. To reiterate, for the future paths of the remaining fiscal variables, we assume that G_t and TR_t evolve such that the ratios of these expenditures to GNP are consistent with those projected for the Japanese economy by Fukawa and Sato (2009). It is assumed that the ratios at 2050, 25 percent and 18 percent, respectively, remain constant for the indefinite future. The tax rates on labor and capital income, $\{\tau_{h,t}, \tau_{k,t}\}_{t=2009}^{\infty}$, remain constant at their assumed or calculated values in 2008.

9. Note that the adjustment constant 0.90 is also applied to the hypothetical raised values of the consumption tax.

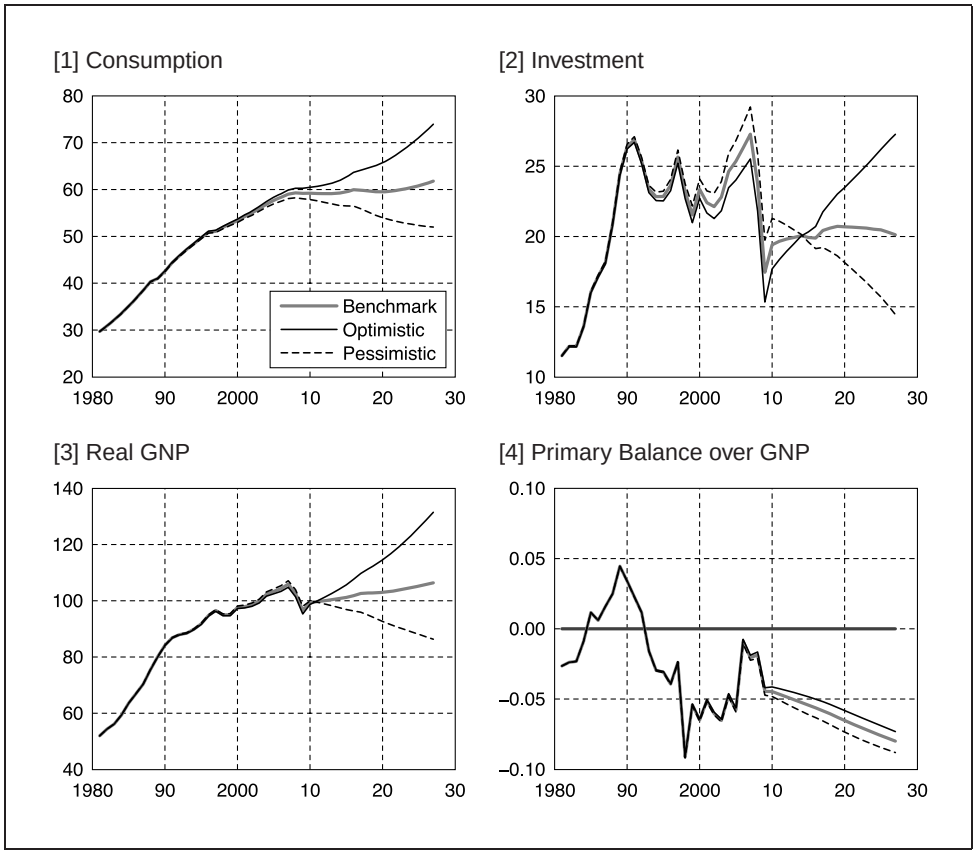
1. Benchmark policy: Do nothing

Figure 9 displays the response of the economy to the benchmark policy of keeping the consumption tax rate at 5 percent for a long time. In each frame, three different "growth" scenarios are considered. The middle curve represents the benchmark value of the growth rate of TFP at 1 percent over the next 20 years. In addition, we display the responses of the aggregate variables under a pessimistic TFP growth rate of 0 percent and an optimistic value of 2 percent.

Starting from 2010, the economy follows increasingly different paths depending on the assumed rate of growth of TFP. For example, there is a slight increase in investment in the short run in the benchmark case. This reflects the added incentive to save and invest with a 1 percent TFP growth rate that is slightly above the average TFP growth rate over the last two decades. However, given our assumption that the TFP growth rate increases to its long-run value of 2 percent starting in 2029, investment slows down until then to take advantage of the higher returns to capital income after 2029.

With a zero TFP growth rate in the pessimistic case, economic activity declines as indicated by the declines in consumption, investment, and output in Figure 9. The optimistic case shows an increase in all economic aggregates.

Figure 9 Consumption Tax Kept at 5 Percent



Regarding the impact on the primary balance of "doing nothing," the implications of maintaining the consumption tax rate at 5 percent for a long time are independent from the assumed TFP growth rate. In all scenarios for growth, the primary balance is always negative from 2009 onward. Furthermore, it grows in absolute value due to our assumption of projected increases in aging-related expenditures in pensions, health insurance, and long-term care for the elderly.

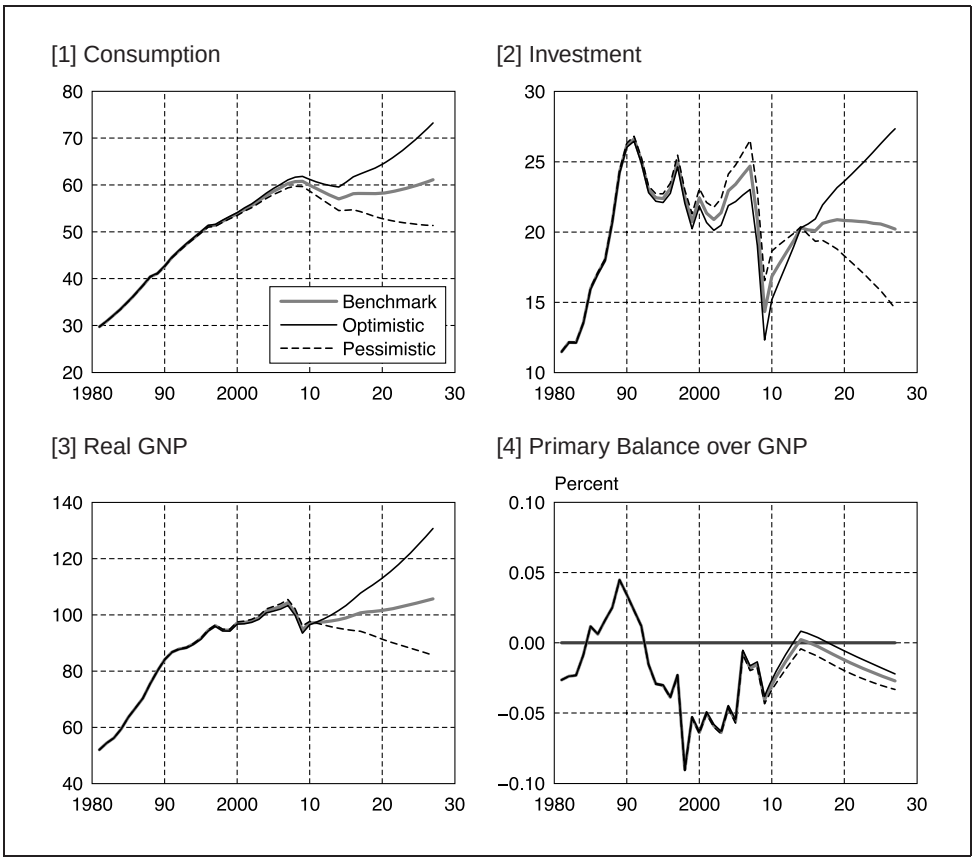
Therefore, "doing nothing" is not a policy option for the Japanese government if the objective is to turn a positive primary balance in the near future. Some taxes must be raised, or expenditures must be cut severely. The next subsection will explore the implications of raising the consumption tax to 15 percent to achieve the fiscal objective.

2. Policy 1: A gradual rise of the consumption tax in five years to 15 percent by 2014

Figure 10 shows the impact of a gradual 2 percentage point per year increase in the consumption tax, starting in 2010. Under this counterfactual experiment, the tax on consumption becomes 15 percent in 2014 and remains at this level forever.

Under both the benchmark TFP growth rate of 1 percent and the optimistic growth rate of 2 percent over the next 20 years, the primary balance temporarily turns positive

Figure 10 Gradual Increase in Consumption Tax to 15 Percent



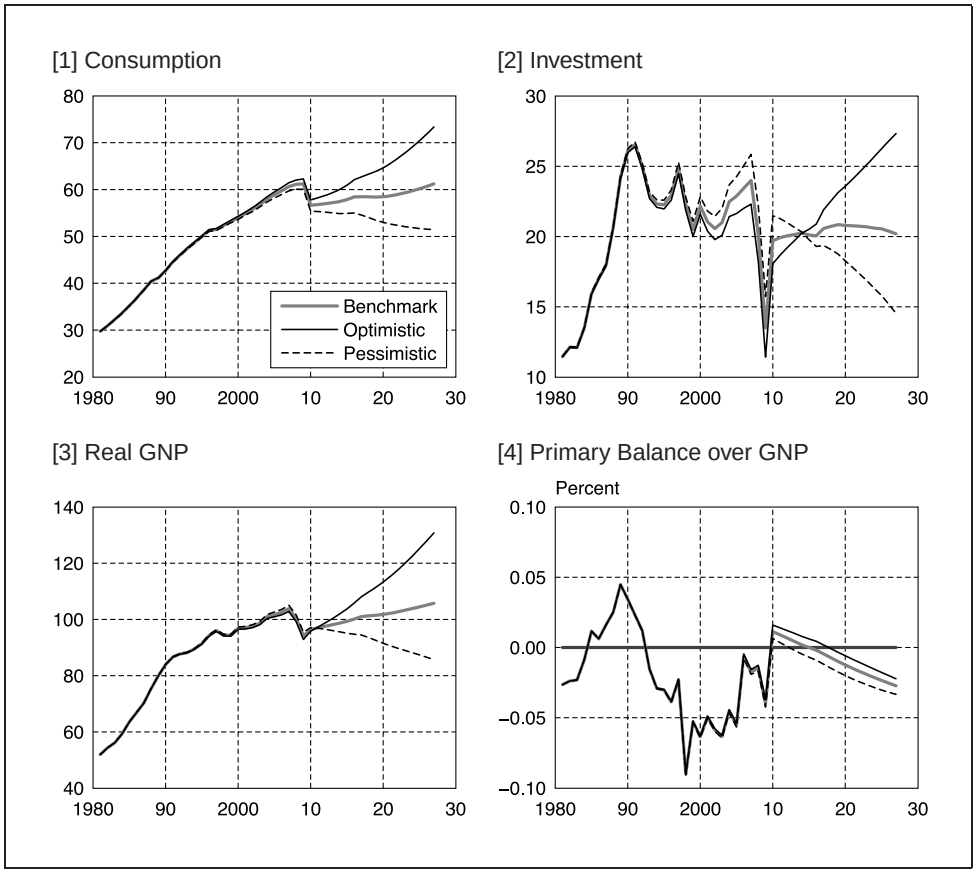
but eventually becomes (increasingly) negative. With a zero TFP growth rate, the primary balance is never positive. Put differently, even a reasonable growth rate of 2 percent over the next 20 years is not sufficient to permanently enlarge the tax base to deliver persistent primary surpluses, despite a gradual increase in the consumption tax rate to 15 percent in five years. Indeed, the primary surplus in this case is very short lived.

3. Policy 2: A sudden rise in the consumption tax rate to 15 percent in 2010

Figure 11 shows the results of model simulations when the consumption tax is raised in one step in 2010 from 5 percent to 15 percent. Similar to our previous experiments, this policy change is also perfectly anticipated by economic agents.

According to the figure, a primary surplus can be obtained in 2010 easily if the consumption tax is raised in one step, regardless of the TFP growth rate. The scope for achieving a primary surplus is clearly larger with a sudden increase in the consumption tax rate. However, in any case, the primary balance turns negative again very quickly. For the 1 percent growth case, the primary balance is positive for only a few years, and for the 2 percent growth rate case it is positive for about seven years.

Figure 11 Sudden Increase in Consumption Tax to 15 Percent



There is very little difference in the way the economy responds to the gradual versus the sudden increase in the consumption tax, since the agents face complete markets and perfect foresight. As a result, the consumption tax base behaves quite similarly across these two fiscal policies. However, the government accounts improve more quickly, almost immediately, when the consumption tax rate is raised in one step, whereas it improves very gradually, if at all, and is subject more to the additional effect of economic growth when the tax is raised gradually.

The take-away from the first two experiments is that even a 10 percentage point increase in the consumption tax rate, from 5 percent to 15 percent, is insufficient to yield a consistent stream of positive primary balances under the benchmark assumptions on government expenditures. There are three possible avenues for a more persistent improvement in government accounts: (1) economic growth faster than 2 percent; (2) containment of government expenditures with possible reductions in purchases or social security; and (3) a larger tax increase. We consider some of these experiments in the next section.

VI. Sensitivity Analysis

In this section, we explore the sensitivity of our results to various assumptions made in the previous analysis. First, we study a simple form of uncertainty in the counterfactual experiments. Next, we study the impact of other assumptions on government purchases and transfer payments on the outcome of the fiscal experiments.

A. Surprise TFP Growth Rates after 2009

In our policy experiments, the agents are assumed to have perfect foresight about the TFP growth rates for 2010 and beyond. In this subsection, we study whether our assumption of perfect foresight is critical for the results. In particular, we now assume that the agents think that the TFP growth rate will be 1 percent in 2010 and beyond, act accordingly starting from 1981, but then are surprised to find a different TFP growth rate for 2010 and beyond. We consider two experiments; they find out in 2009 that the growth rate is either 0 percent or 2 percent. Figures 12–13 display the results of these experiments.

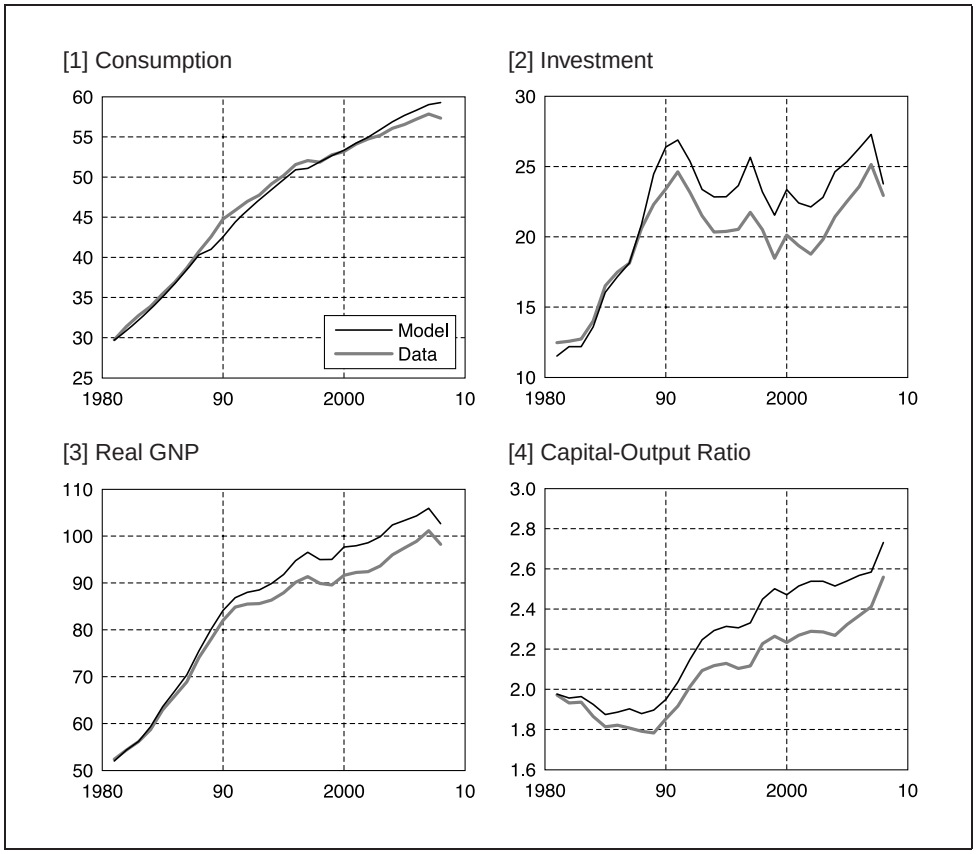
In terms of the behavior of the national accounts, this economy is very similar to the benchmark economy. Figure 12 shows that the fit of the model under a surprise change in the TFP growth rate in 2009 is very similar to that of the perfect-foresight case.

Even the government accounts behave quite the same, as Figure 13 indicates.

In terms of the impact on policy, there are no differences, as depicted by Figure 14. If the Japanese government does not change the consumption tax rate from its current level of 5 percent, a primary balance is never achieved, regardless of the assumed TFP growth rate for 2010 and beyond.

Figures 15 and 16 replicate the two tax experiments in this non-perfect-foresight environment. Once again, the results are nearly identical to the benchmark case of perfect foresight.

Figure 12 Aggregates with a Surprise TFP Growth Rate in 2009 and After

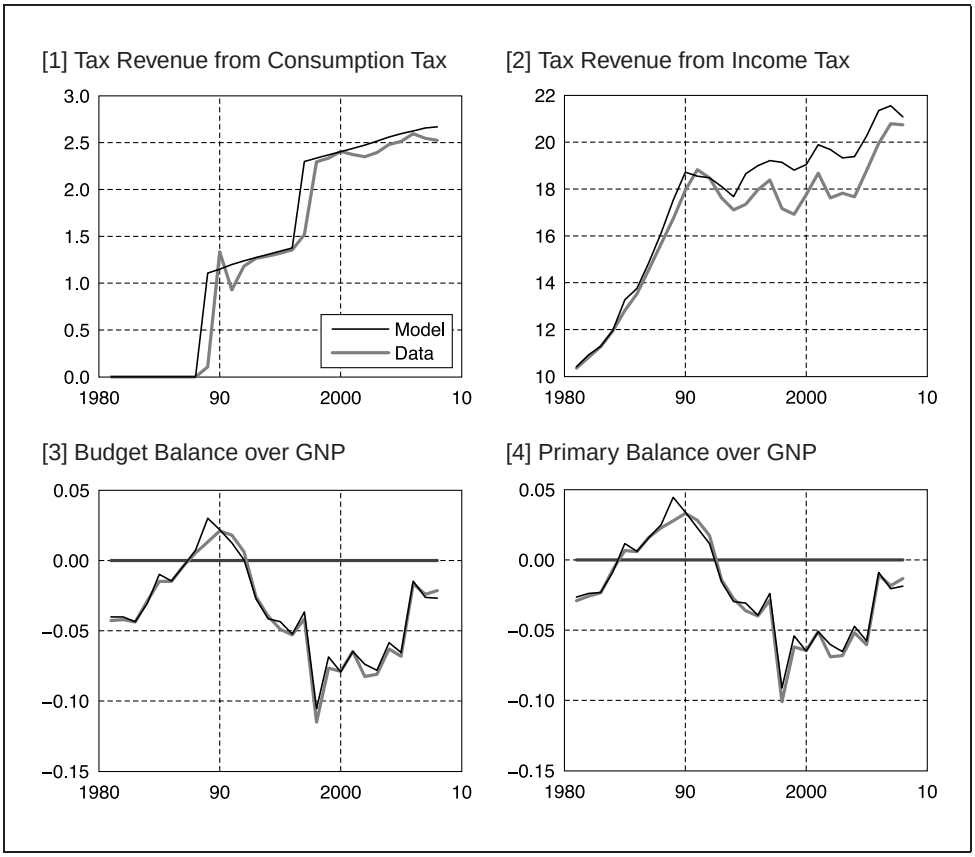


As a result, we conclude that our perfect foresight assumption regarding the TFP growth rate has no influence on the quantitative findings. This is consistent with a number of similar findings in the related literature.

B. Alternative Assumptions on G_t and TR_t

In an evaluation of how tax policy affects the primary balance, assumptions on future government purchases and transfer payments, in addition to assumptions on growth that affect the tax base, are critical. In our previous results, we maintained the assumption that both the government purchases to GNP ratio and transfer payments to GNP ratio rise according to the estimates provided by Fukawa and Sato (2009). Briefly, these expenditure items are assumed to rise from their 2008 values of around 20 percent and 14 percent to 25 percent and 18 percent, respectively, by 2050. Note that these projected increases in government expenditures are due to the aging of the Japanese population and the resulting additional expenditures for retirement benefits, health expenditures, and long-term care for the elderly.

Figure 13 Primary Balance with Surprise TFP Growth



In the next set of experiments, two alternatives will be considered to these benchmark assumptions:

- A "prudent" fiscal policy in which the eventual targets for these expenditure items are lower by 3 percentage points, relative to the benchmark case, with G/Y and TR/Y ending up at 22 percent and 15 percent by 2050.
- An "imprudent" fiscal policy in which the eventual targets for these expenditure items are higher by 3 percentage points, relative to the benchmark case, with G/Y and TR/Y ending up at 28 percent and 21 percent by 2050.

In both cases, as in the benchmark case, the paths for fiscal policy variables linearly rise from the 2008 levels to the assumed 2050 levels.

Figure 17 displays the time paths of the ratios of transfer payments and government purchases to GNP under the benchmark assumptions as well as the two alternatives described above. In the figures and tables below, we will display the effects of counterfactual consumption tax increases on the national accounts and on the primary balance under each expenditure scenario. In addition, we will present the quantitative results for growth rates that are more typical of the Japanese economy after World War II.

Figure 14 No Change in Consumption Tax

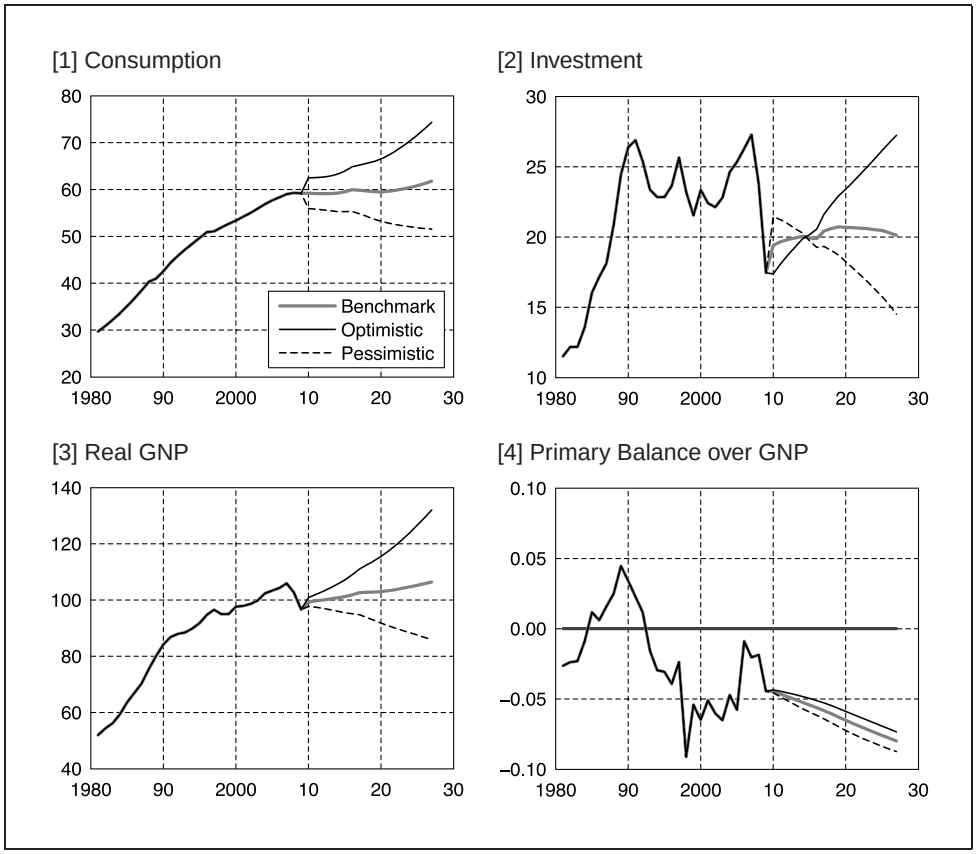
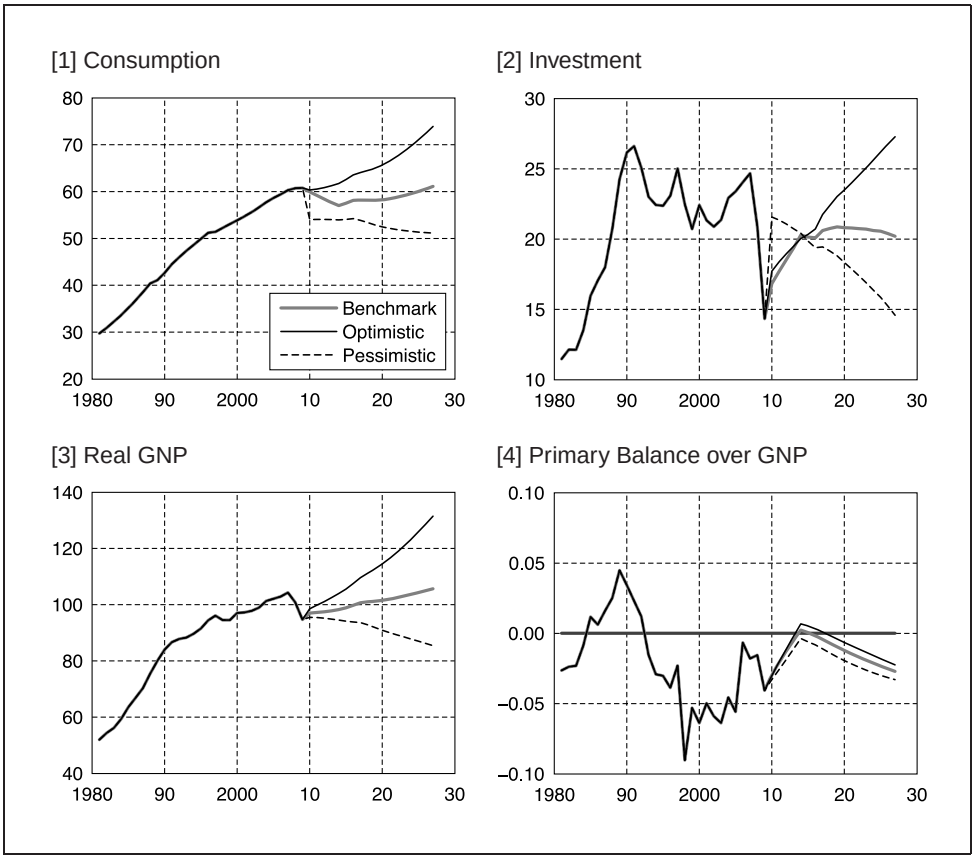


Figure 18 depicts the results of "doing nothing," just maintaining the consumption tax at the current 5 percent level. Under this benchmark policy, even if the "prudent" fiscal policy of 22 percent and 15 percent for G/Y and TR/Y are realized along the path from 2009 to 2050, the primary balance is never positive. Furthermore, under a more "imprudent" expenditure scenario of 28 percent and 21 percent for the expenditure ratios, the primary balance is increasingly negative, reaching unprecedented levels. As in the original case, some tax must be raised if the government wants to turn a positive primary balance in the face of uncontrolled expenditures.

Figure 19 displays the findings of a gradual increase in the consumption tax to 15 percent in 2014, starting in 2010. The benchmark assumption replicates the earlier results. The primary balance temporarily turns positive only for a few years, but quickly becomes negative and continues to worsen. With the imprudent expenditure scenario, the primary balance never turns positive despite the additional 10 percent consumption tax. Only with the prudent expenditure policy does the primary balance sustain a positive value for at least two decades. Even under these conditions, however, the primary balance is trending down and will eventually turn negative once again.

Figure 15 Gradual Increase in Consumption Tax to 15 Percent

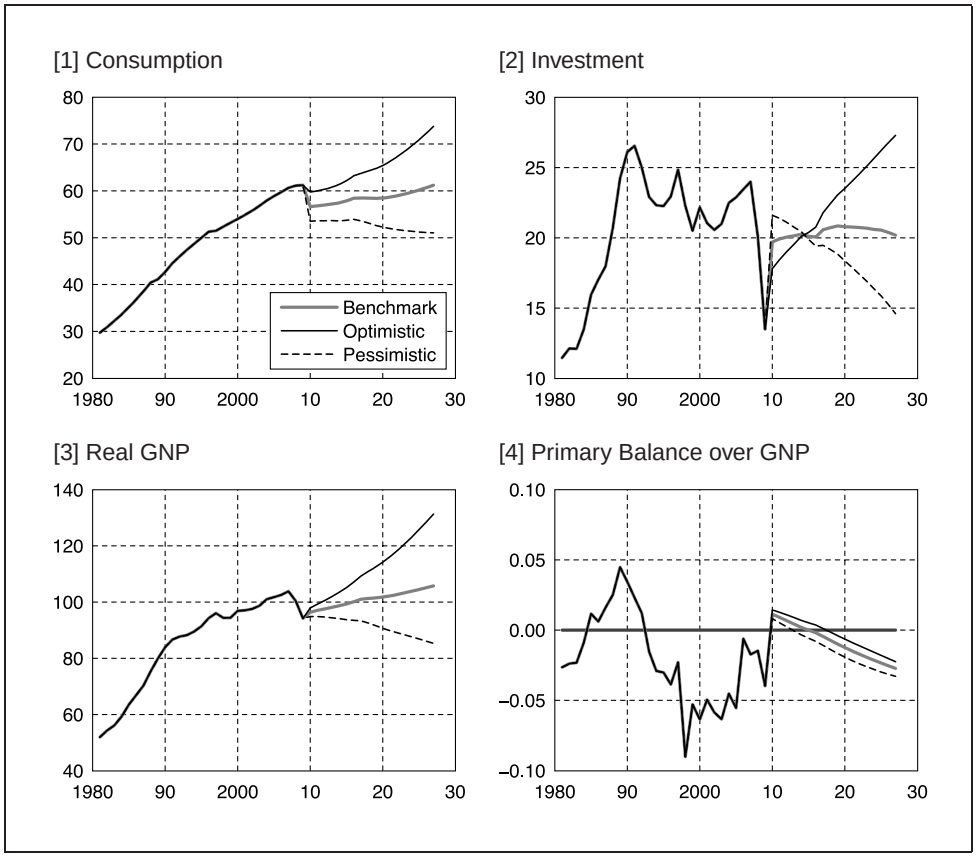


When the consumption tax is raised in one step, from 5 percent to 15 percent, the primary balance turns positive immediately, as Figure 20 shows. Despite this quick response, the behavior of the primary balance after this initial development is entirely dependent on the assumed paths for government expenditures. Similar to the case of a gradual increase in the consumption tax, the primary balance deteriorates, and the rate of worsening is faster with the imprudent policy. These counterfactual experiments indicate the critical role of the Japanese government's expenditures in controlling the future path of its budget. Although this point is qualitatively obvious, it is the quantitative nature of our experiments that emphasizes the degree to which this statement is valid.

Would faster economic growth help achieve a primary balance and possibly maintain it for a long period of time? To address this question, we repeat the above experiments using TFP growth rates of 2 percent and 3 percent, in addition to the benchmark value of 1 percent, for all three government expenditure assumptions.

Tables 3–5 present the results under the two alternative government spending assumptions, together with the benchmark fiscal policy assumptions. These tables take

Figure 16 Sudden Increase in Consumption Tax to 15 Percent

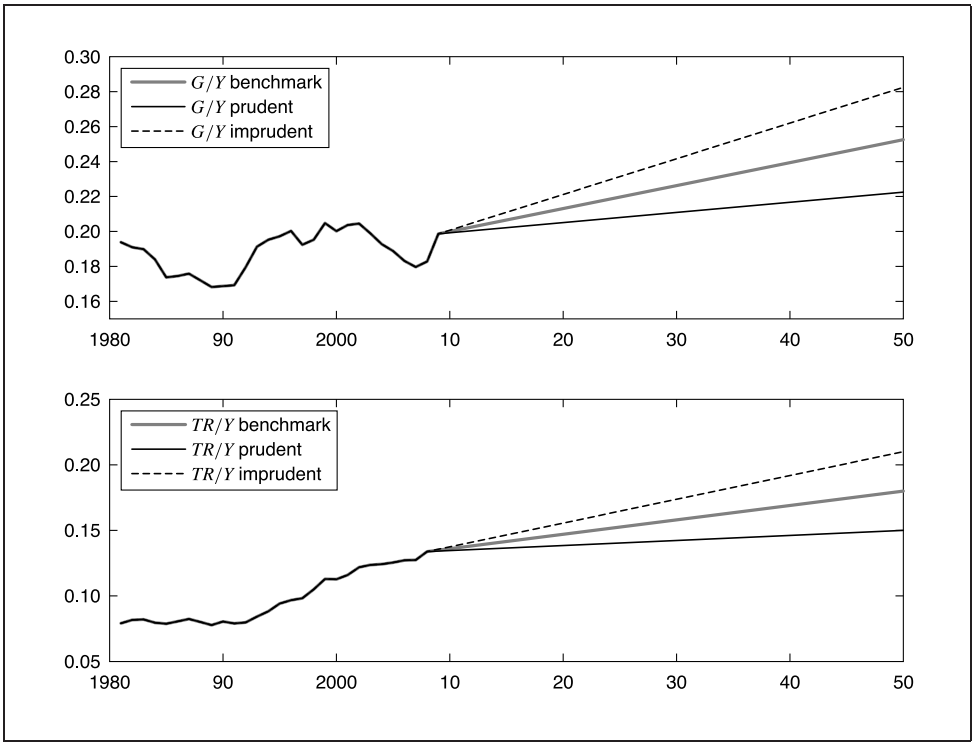


successively higher TFP growth rates into account to see how growth interacts with various expenditure assumptions. Note that in the tables below, we report the first year that the primary balance turns positive. A dash indicates that the primary balance remains negative throughout the "forecast" period of 2009–28. A second year inside the parentheses indicates that the primary balance turn negative again in that year and remains negative throughout.

According to Table 3, under the benchmark TFP growth rate assumption of 1 percent and under the "do nothing" policy of keeping the consumption tax at 5 percent, a primary surplus is never obtained. In other words, even under a prudent fiscal policy that achieves a reduction of 3 percentage points in ratios of government purchases and transfer payments to GNP by 2050, which goes against the projections of economists, a rise in the consumption tax seems necessary to achieve a primary surplus.

A gradual or a sudden rise in the consumption tax to 15 percent delivers a positive primary balance under all of the fiscal assumptions. However, these gains are temporary. In the imprudent policy case, even a gradual rise in the consumption tax does not deliver a positive primary balance. With a gradual policy, the primary balance eventually turns

Figure 17 Alternative Assumptions on Government Expenditures

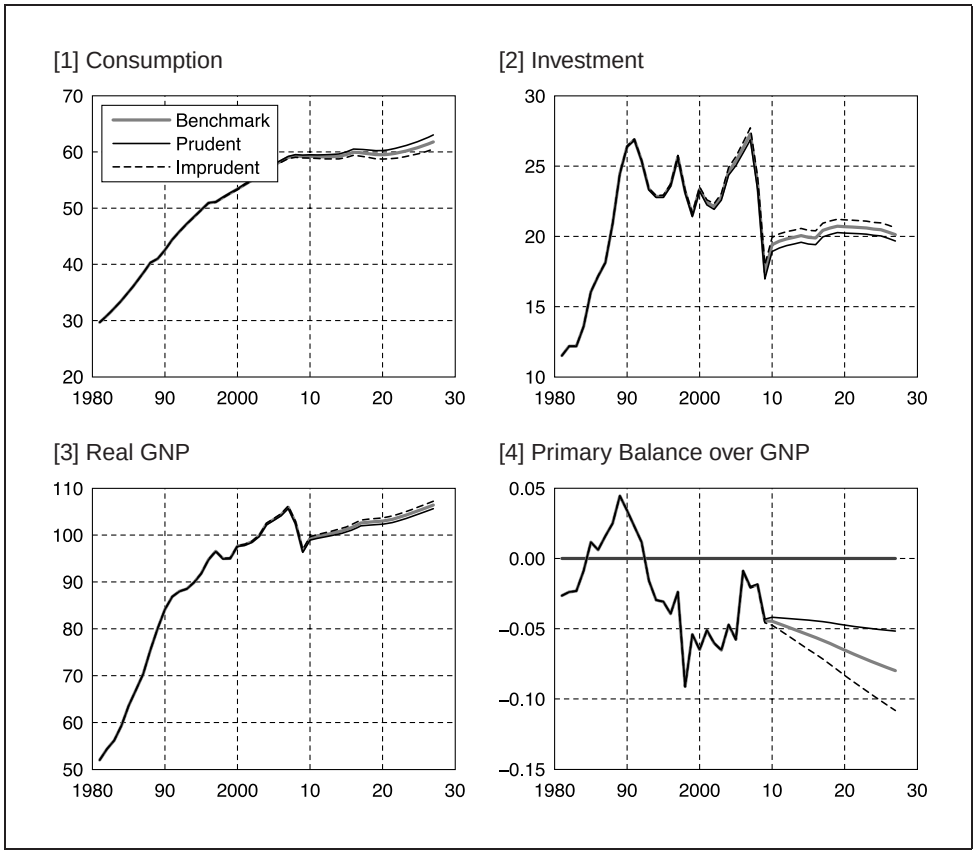


negative even with the prudent expenditure policy. With a sudden rise in the consumption tax to 15 percent, gains are temporary; three to five years under the benchmark and imprudent expenditure policies, and about 24 years under the prudent policy.

Tables 4 and 5 take increasingly optimistic views on the growth rate of TFP, which determines the pace with which the tax base will grow. The message in these tables is similar to that given above. However, faster economic growth certainly raises the tax base and helps the government achieve a primary surplus faster or maintain it longer. For example, with a 2 percent TFP growth rate, an increase in the consumption tax rate, gradual or sudden, generates a primary surplus under both the benchmark and prudent fiscal policies. Even under the imprudent fiscal policy, the primary surplus is maintained for a few years if the consumption tax rate is raised in one step. In all cases, the primary balance deteriorates over time and eventually turns negative, emphasizing the importance of further fiscal discipline.

Table 5 presents the numerical results of the same counterfactual experiments under the more optimistic TFP growth rate assumption of 3 percent. As before, a primary surplus is never achieved under the "do nothing" policy. Is higher economic growth critical in correcting the fiscal imbalance? Would growth-promoting policies pay dividends in the future? According to Table 5, slowing the growth of government expenditures is far more important.

Figure 18 No Change in the Consumption Tax (5 Percent)

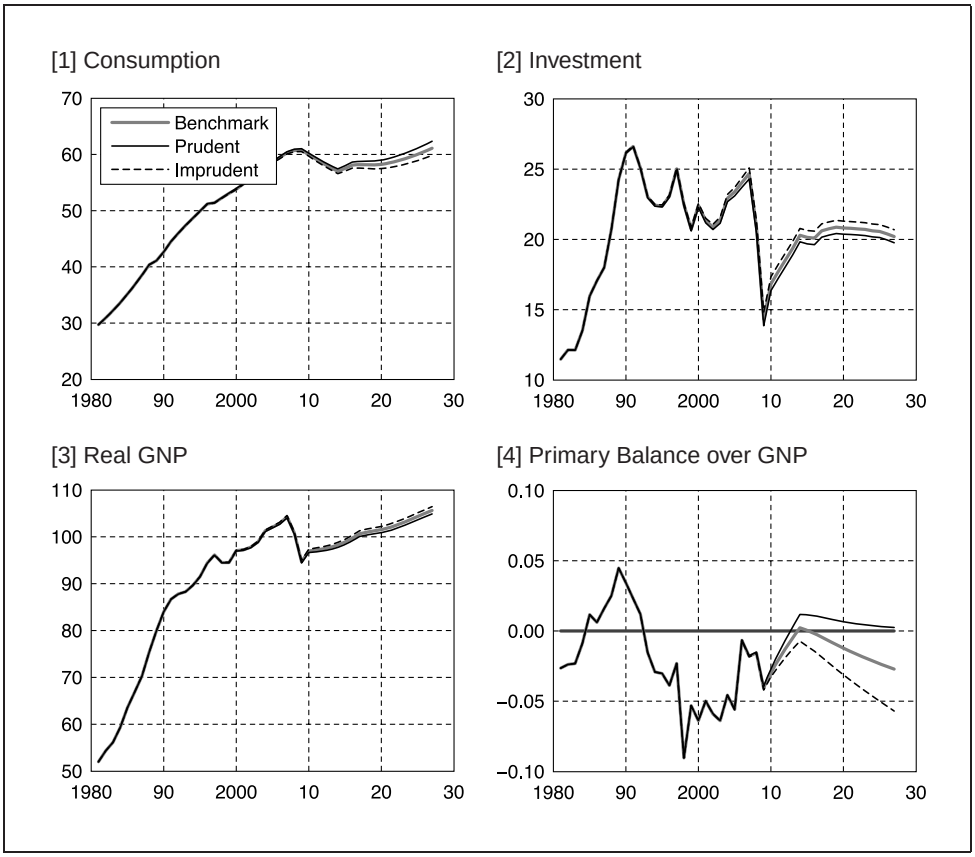


This subsection has demonstrated the importance of containing government purchases and transfer payments as well as faster economic growth in producing a positive primary balance. If one takes the view that the government expenditures are mostly dictated by the projected aging of the Japanese population and therefore difficult to contain, then the fiscal authority is faced with the difficult task of either raising the consumption tax beyond 15 percent or implementing an increase in the labor income tax rate, unless the performance of the Japanese economy improves significantly. Of course, any increase in the labor income tax rate would have some distortionary consequences and harm economic growth, making the task of achieving a primary surplus that much more difficult.

C. Surprise Increases in the Consumption Tax Rate

In order to study the role of our perfect foresight assumption regarding the increase in the consumption tax rate, this subsection presents the results from an experiment in which individuals are surprised by a tax increase announcement in 2009. In the experiment with a gradual increase, the government makes an unexpected announcement in 2009 that the consumption tax rate will be raised in 2010 by 2 percentage points

Figure 19 Gradual Increase in the Consumption Tax to 15 Percent



and this will be replicated each year until the rate reaches 15 percent by 2014. In the alternative experiment, the government announces in 2009 that the consumption tax will be increased from 5 percent to 15 percent in one step in 2010. In all cases, we use the benchmark assumptions on the growth of government expenditures.

Figure 21 shows that a primary surplus is achieved more quickly if the tax rate is raised in one step, but the primary balance worsens very quickly. By about 2016, the government is again facing a negative primary balance. These results are very similar to those in the perfect-foresight case in which a primary surplus is never obtained in the "do nothing" case, and it is achieved only temporarily in the case of a rise in the consumption tax.

Figure 20 Sudden Increase in the Consumption Tax to 15 Percent

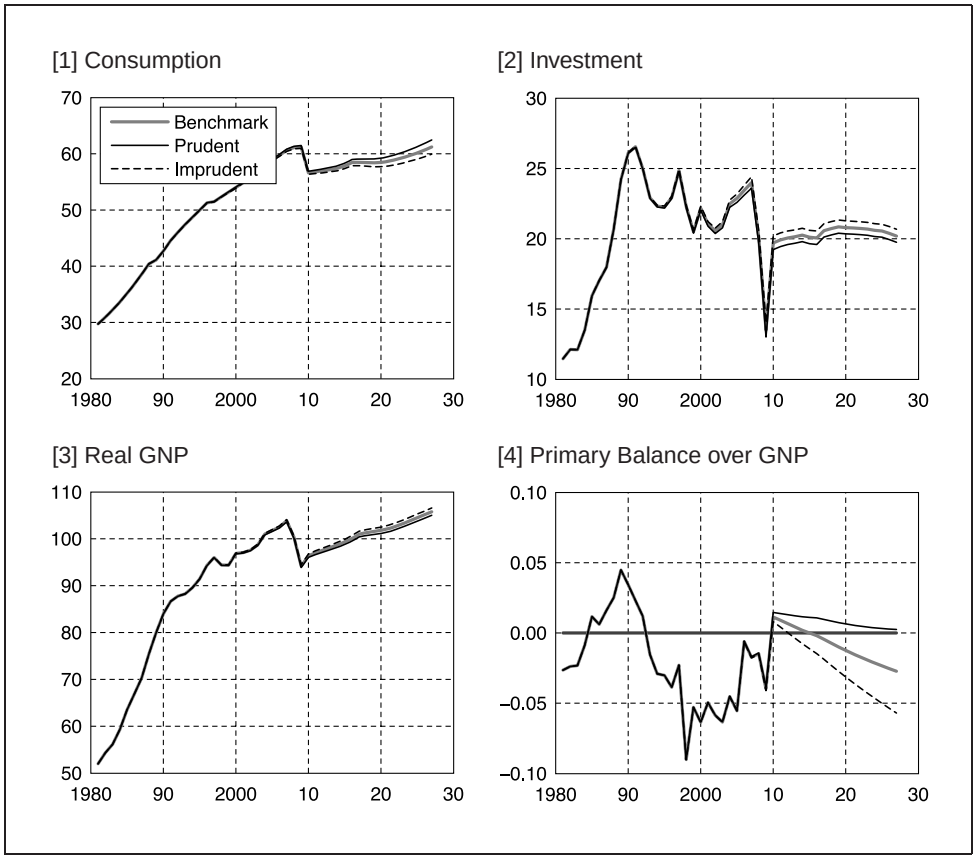


Table 3 First-Year Primary Balance Becomes Positive, $\gamma = 1.01$

	Prudent policy	Benchmark policy	Imprudent policy
Do nothing	—	—	—
Gradual increase	2013 (2034)	2014 (2016)	—
Sudden increase	2010 (2034)	2010 (2015)	2010 (2013)

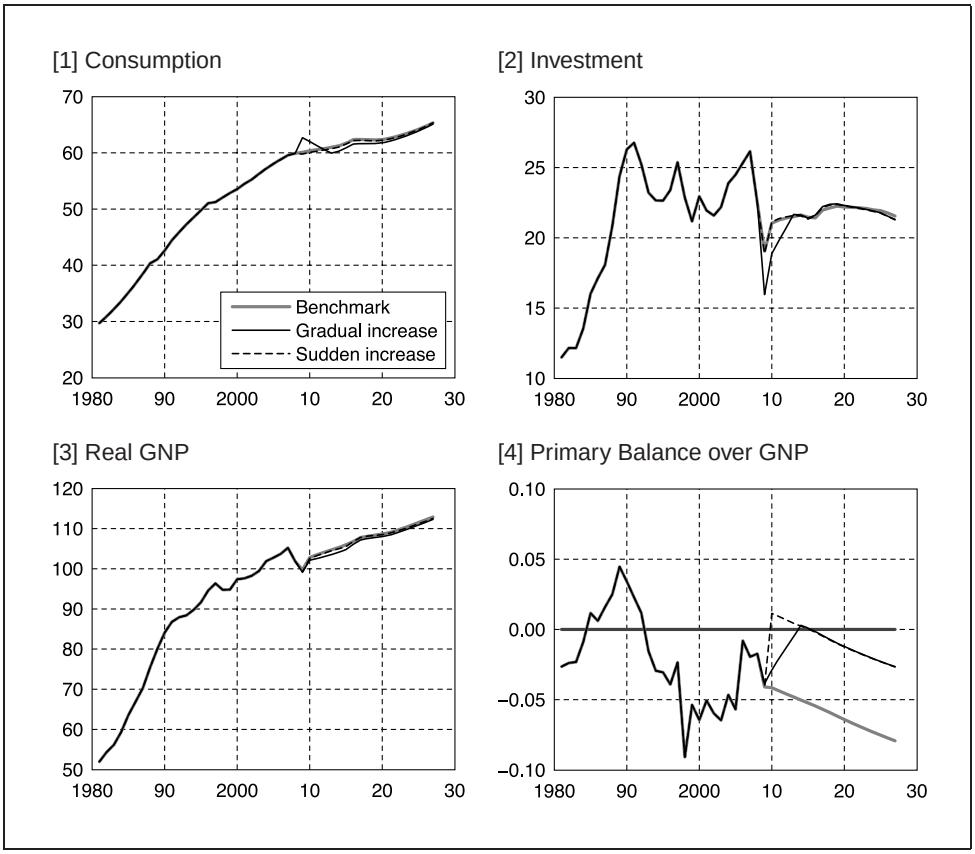
Table 4 First-Year Primary Balance Becomes Positive, $\gamma = 1.02$

	Prudent policy	Benchmark policy	Imprudent policy
Do nothing	—	—	—
Gradual increase	2013 (2036)	2013 (2018)	—
Sudden increase	2010 (2036)	2010 (2018)	2010 (2014)

Table 5 First-Year Primary Balance Becomes Positive, $\gamma = 1.03$

	Prudent policy	Benchmark policy	Imprudent policy
Do nothing	—	—	—
Gradual increase	2012 (2038)	2013 (2020)	2014 (2016)
Sudden increase	2010 (2038)	2010 (2020)	2010 (2016)

Figure 21 Surprise Increase in Consumption Tax to 15 Percent



VII. Conclusions

The Japanese government responded to the "lost decade" in part by significantly increasing its spending and thereby raising its debt to output ratio to the highest level among advanced economies. This raised concerns about further fiscal issues, and recent research has focused on the effects of fiscal policy on the Japanese economy and on the government's primary balance.

This paper uses the standard growth model to measure the impact of a menu of fiscal policy choices available to the government on Japanese national and government accounts. The model is a general equilibrium model with complete markets and perfect foresight. A representative household and a stand-in firm take factor prices, demographics, and government expenditure and taxation policies as given, and maximize their objective functions with respect to their budget constraints. The government finances its exogenous spending with taxes on factor incomes and consumption.

Our quantitative findings suggest that the most important factor in obtaining a primary surplus in the near future and in maintaining it for many years is fiscal reform. The fiscal authority must contain future government purchases and transfer payments.

As a second factor, improved performance of the Japanese macroeconomy through faster productivity growth is also important. Put differently, increases in the tax base through economic growth will enable the Japanese government to reach a primary surplus sooner, but to make these gains permanent the government needs to slow the growth of expenditures. In particular, projected increases in social security expenditures, driven by the aging of society, point to a serious issue if the goal of policy is to reverse the recent trend of primary deficits that add to the already high public debt.

Our quantitative results are obtained in the most basic growth model that abstracts from potentially important economic factors. Allowing for endogenous labor and considering a wider array of fiscal policy choices are clearly desirable. These and other important extensions are left for future research.

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