
Is the Sky the Limit?

Can JGBs continue to defy gravity?

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Is the Sky the Limit?  
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1. Introduction

It is well-known that Japan has the highest debt to GDP ratio among OECD countries, much higher than some European countries, such as Greece, Portugal, and Ireland, which have been in sovereign debt crisis since 2010. The fiscal deficits relative to GDP have been also large, but fiscal consolidation plans for Japan have been postponed several times. Many academic papers have already examined the sustainability of Japanese public debt. Almost all of them, including Doi (2009), Doi, Hoshi and Okimoto (2011), Doi and Ihori (2009), Sakuragawa and Hosono (2011), Ito (2011), Ito, Watanabe, and Yabu (2011), and Ostry et al. (2010), found that the fiscal situation is on an unsustainable path. Without a drastic change in fiscal policy, the rising trend of Japanese government debt to GDP ratio cannot be reversed.

This paper has two distinct features. First, most papers judge sustainability by examining whether the debt to GDP ratio is expected to come back down to the current level in some distant future. No attention is paid to how high the debt to GDP ratio will climb before it eventually comes down. This paper considers an explicit ceiling that the government debt should not exceed at any point of time. For Japan, we argue such a ceiling is determined by the amount of financial assets held by the domestic private sector.² When the financial market believes the government debt will soon exceed the entire domestic private sector financial assets, it sees that any newly issued bonds will have to be absorbed by foreign investors, who would ask for higher interest rates than the Japanese domestic investors. This will lead to a sharp rise of the bond yield. Since the yield changes as soon as the financial market changes the expectation, such a change can happen abruptly. If the sudden increase in the bond yield (sudden decline in the bond price) prompts the investors (including Japanese ones) to sell the government bonds to limit the loss, the bond price would fall further. The price falls will increases the bond sales by the investors who want to sell out before the

¹ The earlier version of some parts of this paper was included in an NBER working paper (Hoshi and Ito, 2012).
² IMF (2009) and Tokuoka (2010) all discuss the ceiling of private sector savings and provide simple calculations.

This paper provides refinements over these earlier attempts by considering the dynamics carefully under several alternative scenarios.
price falls even more. Such fire sale of the bonds can lead to a serious debt crisis.

Second, this paper focuses on the central government budget and its bond issues. Many papers use the concept of “general government” that consolidates local governments and other government accounts, such as social security funds. In several fiscal crises, we have observed countries choose to default on central government bonds, even when countries have wealthy local governments or ample government assets. Thus, the fiscal sustainability of the general government does not necessarily imply the sustainability of the central government bonds. Knowing this, the financial market may start to sell the central government bonds if it questions the sustainability of the central government fiscal situation even when the debt for the general government sector as a whole is sustainable.

The rest of the paper is organized as follows. Section 2 starts by reviewing the various definitions of Japanese government debt. We clarify how the Japanese government bonds (JGBs) that we focus in this paper are related to other components of the general government debts. Section 3 provides a brief overview of the evolution of budget deficit and JGB issues in the last 20 years. The section identifies the key contributors to the widening budget deficit and ever increasing JGBs. Despite the increases in JGBs, especially in the late 2000s, the yields on JGBs have been remarkably low as Section 4 describes. The section also reviews some explanations for the continued low yields for JGBs that have been put forward by many observers. Section 5 reports various simulations of the future paths for JGBs under different scenarios. Section 6 concludes by summarizing the paper’s findings and speculating what would happen if the JGB yields indeed jump up suddenly.

2. Defining Japanese Government Debt

There are several different definitions of Japanese government debt, and depending on which definition is used, the amount can be very different. Table 1 shows the three alternative definitions of Japanese government debt that are often used.

| Panel A shows the definition of Japanese government debt as reported to the IMF. This definition captures the liabilities incurred by the central government. It includes the total outstanding of JGBs including FILP (Fiscal Investment and Loan Program) bonds, other long-term borrowings, Financial Bills, and (explicit) government guarantees. As of the end of fiscal year 2010, the amount of JGBs including FILP bonds amounted to about 750 trillion yen (about 150% of GDP).

FILP bonds are the JGBs issued to finance some government agencies covered by the FILP, such as the Japan Finance Corporation, the Urban Renaissance Agency and others. Local governments are also major recipients of the FILP funds. Before the FILP reform of 2001, the FILP was financed by the Trust Funds Bureau of the Ministry of Finance that collected funds from the |
postal savings and the national pension funds in the form of deposits. After the reform of 2001, the postal savings and national pension funds were no longer required to deposit their funds to the Ministry of Finance. The agencies in the FILP are encouraged to raise the funds in the market by issuing FILP Agency Bonds, but those that have trouble raising sufficient funds in the market can rely on the Fiscal Loan Funds (created by reorganizing the Trust Fund Bureau), which are funded by FILP bonds (zaitō bonds). The distinction between the regular JGBs and the FILP-JGBs is purely accounting.3

In addition to JGBs and FILP bonds, the central government has long-term borrowings of about 60 trillion yen and short-term Treasury Bills of about 110 trillion yen. In 2009, the government merged Financing Bills (FBs) and Short-term discount bills into Treasury Bills (T-bills). They are issued primarily to fund foreign reserves that are held in a special account of the central government. They are rolled over every 2 to 3 months and have offsetting entries on the asset side of the balance sheet (foreign reserves).

The central government also guarantees bonds issued by some government agencies such as the Deposit Insurance Corporation, the Development Bank of Japan, and Japan Highway Corporation. The total guaranteed liabilities amount to about 45 trillion yen. In total, the government debt according to Panel A definition was about 970 trillion yen as of the end of fiscal 2010 (March 2011).

Panel B definition covers both central and local governments. Compared with Panel A definition, this definition adds bonds issued by local governments, but excludes the FILP bonds, Financial Bills (FBs), and government guarantees. According to Panel B definition, Japanese government debt was forecasted to be about 890 trillion yen as of the end of fiscal 2011.

Panel C of the table shows the definition used in national income accounting. Compared with the second column, this definition adds FBs as well as the government guarantees back, but excludes FILP bonds. Moreover, this definition adds the liabilities in the social security funds, which are included in the general government sector in the national income accounting. Altogether, the Japanese government debt at the end of fiscal 2009 was 1,023 trillion yen (214% of GDP) according to Panel C definition.

In this paper, we adopt a narrow concept and only considers JGBs. The main reason for this choice is that it corresponds to the annual budget of the central government. Any short-fall of the budget results in the new incremental issues of JGBs. We also note some other government liabilities have corresponding assets. For example, T-bills have corresponding assets, most of them in US Treasuries, so even in crisis, the special account would not become insolvent. FILP bonds also have corresponding assets that can be sold (privatized) assuming FILP agencies are solvent.

3 For more details on the FILP, see MOF (2010). The FILP bonds are physically indistinguishable from JGBs, but they are excluded from some definitions of government liabilities because they are supposed to be redeemed by future revenues of the FILP agencies rather than tax revenues. The idea that the taxpayers would not be called on to pay for the losses in FILP agencies, however, is questionable as Doi and Hoshi (2003) points out.
3. Deficits and Debt of the Central Government

3.1. Definitions and Overview

Let us start by looking at major line items of the central government general budget. On the revenue side, there are three major taxes: (personal) income tax, corporate (income) tax, and consumption tax. There are other taxes and fees that the central government collects. Other than these tax and fee revenues, the government receives revenues from government run businesses (such as hospitals) and by selling government assets (such as national land). These non-tax revenues are classified into other revenues. The revenue side of the budget also includes the revenue from new issues of bonds, but we treat the bond revenue separately. Thus, we define the central government revenue as follows.

\[ \text{Revenue} = \text{Income Tax} + \text{Corporate Tax} + \text{Consumption Tax} + \text{Other Taxes} + \text{Other (Non-Tax) Revenues} \]

On the expenditure side, there are two expenditure items that are important in considering the debt dynamics for Japan. Social security related expenditure is expected to increase with aging. Debt service is expected to increase with the outstanding balance of JGBs. Other expenditures include public works, transfers to local governments, expenditures to support education, science and culture, and other expenditures. Thus, the total central government expenditure is expressed as follows.

\[ \text{Expenditures} = \text{Social Security related Expenditure} + \text{Debt Service} + \text{Education, Science and Culture Expenditures} + \text{Transfers to Local Governments} + \text{Public Works} + \text{Other Expenditures} \]

The central government deficit is the difference between thus defined total expenditures and revenues:

\[ \text{Deficit} = \text{Expenditures} - \text{Revenue} = \text{New JGB Issues} \]

Thus, the outstanding debt changes according to the following dynamics.

\[ JGB_t = JGB_{t-1} + \text{Deficit}_{t-1} \quad (1) \]

Note that the expenditures and hence deficit include the debt services. Figure 1 shows total expenditure (higher line), total revenues (lower line), and deficit (bar) for the central government of Japan from fiscal 1975 to fiscal 2011. Total expenditure is the size of the budget (general account), including interest payment and amortization of JGBs. Total revenue includes both tax and non-tax revenues, but excludes cash raised by issuing new JGBs. The difference between expenditure and revenue is fiscal deficit.

The figure reveals that expenditure and revenue moved in parallel until 1991. Although there was a small gap between the two lines, the distance (deficit) did not expand over time. On the
contrary, the gap narrowed in the late 1980s.

In 1991, the two lines started to diverge. Revenue started to show a declining trend, while expenditure continued to increase. Except for the period between 2003 and 2007, when revenue increased and expenditure came down, the deficit widened every year. A runaway deficit emerged.

Fig. 1. General account, tax revenue and expenditures

Figure 2 shows the climb of JGB outstanding over these years. There are three types of government bonds, though the difference is purely in accounting. Construction bonds that are issued for some public work projects steadily increased from 1975 to around 1995. After the mid-1990s, increases in deficit bonds that are issued to fill the fiscal gap outpaced increases of construction bonds. The new category of reconstruction bonds was added in 2011. The reconstruction bonds were issued to finance reconstruction of towns and communities that were destroyed by the Great East Japan Earthquake on March 11, 2011. Figure 2 shows the outstanding amount of each of the three types of bonds at the end of each fiscal year.

In the same graph, the JGB to GDP ratio is shown in solid line. In late 1998, the JGB to GDP ratio started to rise sharply as the nominal GDP started to fall. Although the JGB to GDP ratio plateaued momentarily in 2005-07, it started to rise even more sharply than before in 2008. The JGB-GDP ratio continued to rise and has reached 140% by fiscal 2012. Now it looks like only the sky is the limit.

Fig. 2. JGB climb

Figure 3 shows the breakdown of government expenditures. One item that has steadily increased was social security related expenditures, which include payments of pension benefits, for medical insurance and long-term care insurance. It increased from 4 trillion yen in 1975 to 28 trillion yen in 2010. Another item that also shows an increasing trend is “transfer to local governments.” In contrast, “defense” and “education and science” grew rather slowly in the last 35 years. “Public works” expenditure has increase from 3.1 trillion yen in 1975 to 13.1 trillion yen in 1993, but then fell to 5.7 trillion yen by 2010. The “interest payment” (and amortization) shows a steady rising trend. Although the interest payment sometimes declined reflecting lower interest rates, the impacts of increasing amount of JGBs seem to have started to dominate. By 2010, the interest payment has reached 19.5 trillion yen.

Fig. 3: Expenditure items

Figure 4 shows major tax revenues for the central government of Japan from 1975 to 2012. The consumption tax, or value added tax (VAT) was introduced in 1989, replacing excise taxes, with the VAT rate of 3%. The rate was increased to 5% in 1997. The fluctuation of revenues from consumption tax mirrors the GDP (total value added) very well. In recent years, when the GDP has stagnated, the consumption tax has been flat. Although the VAT rate is 5%, only 4% rate (or 80% of tax revenues) goes to the central government. The rest, 1% of VAT (or 20% of VAT revenue), goes to
local governments.

The fluctuations of (personal) income tax and the corporate income tax have been even more sensitive to economic conditions. During the boom years of the 1980s, both tax revenues increased sharply, and then with the burst bubble of the 1990s, both tax revenues plummeted. This suggests that their “incomes” are not only sensitive to the growth rate of GDP but also to capital gains that results from asset price movements. The (personal) income tax revenues increased from 5.5 trillion yen in 1975 to 26.7 trillion yen 1991 and then fell to 13.5 trillion yen by 2011. The corporate (income) tax increased from 4.1 trillion yen in 1975 to 19 trillion yen in 1989, and then decreased to 9.4 trillion yen by 2011.

Figure 4 (VAT, Income and Corporate taxes)

3.2. Decomposition of cumulative deficits

For the fiscal year 1991, the budget deficit was 4.7 trillion yen, or only 0.9% of GDP. By the late 2010, the budget deficit rose to about 40 trillion yen, or more than 8% of GDP. If we cumulate the “extra” deficit (difference between the actual deficit and its 1991 level) from 1992 to 2010, it amounts to 406 trillion yen. We can decompose the 406 trillion yen into two parts: the portion that was generated by larger expenditures than the 1991 level and the portion that was generated by smaller revenues than the 1991 level. The decomposition, given in Tables 1 (for expenditure) and 2 (for revenue), shows that 240 trillion yen (59%) came from expenditure increase and 165 trillion yen (41%) was due to revenue decline.

Tables 2 and 3 also show which categories in expenditures and revenues were most important in increasing deficits. Among the expenditure categories, we see the social security related expenditures contributed most to the increase. This category explains nearly one third of increase in the cumulative deficits. Next, the expenditure of public works was about 14% of increase in cumulative deficits. Increase in the interest payments also explains 7% of the increase in cumulative deficits.

Tables 2 and 3 about here

Among the revenue categories, the decline in the income tax revenue was most important, explaining 45% of the increase in cumulative deficits. The decline in corporate tax revenue explains another 23% of the increase. These increases in deficits (revenue reduction) were partially offset by an increase in consumption tax revenue (-18% of cumulative deficits) and an increase in the other revenues (-11%), which include revenues from sales of shares in (formerly) government owned corporations, but they were not sufficient to maintain the same level of total revenue.

Although the expenditure increases outpaced the revenue decline, they both contributed to the piling up of JGBs. It seems that in order to rectify the situation, both expenditure cut and tax increase have to be employed.
4. Why is the JGB yield so low?

The outstanding amount of JGBs has been increasing fast, as we have seen above. One would expect the interest rate to go up as the debt to GDP ratio climbs higher. With the sign of runaway debt, the market tends to demand higher and higher interest rates. Figure 5 superimposes a line graph of the average 10-year JGB interest rate and the total interest payments on JGBs on a bar graph of the JGB outstanding (Figure 2). The figure shows that the interest rate steadily declined as the amount of JGBs increased. Even the total interest payments declined for a period from late 1990s to mid-2000s.

As mentioned in Introduction, many studies have concluded that Japan’s fiscal situation is not sustainable unless some drastic measures are taken on both expenditure and revenue sides. Nonetheless the JGB interest rate has moved lower and lower. The JGB rate is much lower than sovereign bond rates of any other advanced countries, not to mention European crisis countries, such as Greece, Ireland, Portugal, Spain, and Italy. Why has the JGB yield been so low?

Several factors are identified to have contributed to the low and stable JGB yield (see Ito (2011), and Hoshi and Ito (2012) for example).

First, overwhelming majority of owners of JGBs are Japanese residents, who are risk-averse and home-biased. Therefore, they endure low yields. Second, the domestic savings (especially corporate savings) are ample and still increasing. They were deposited to the bank accounts, and banks use the increased deposits to purchase more JGBs. Third, there is room for fiscal consolidation. The VAT rate is still 5%, well below the European norm. If the government raises the VAT rate to the European level, that may be enough to close the gap between expenditures and revenues.

More than 90% of JGBs are owned by Japanese financial institutions, the Bank of Japan and other Japanese residents. Table 4 shows the breakdown of the owners of JGBs. The figure shows that close to 70% of the JGBs are held by banks (which include postal savings after the “privatization” in 2007) and insurance companies. The direct holdings of JGBs by households and non-financial corporations are not large, but they hold JGBs indirectly because a major portion of their savings is in the form of yen deposits at Japanese banks. It is remarkable that the savings stay in bank deposits even with near-zero interest rates. The Japanese savers have not shifted their assets abroad to pursue higher returns, yet.

Many banks find the JGBs attractive because the investment does not involve currency risk, which has been historically high for foreign bonds. The capital adequacy requirements (Basle I, II, and III) also make JGBs desirable for banks. JGBs (and sovereign debts of many advanced countries) are still assigned zero weights in calculating the risk-weighted assets, either by regulation or by internal models, which determine the minimum amount of capital that banks must hold. Pension funds and insurance companies also seem to be content with holding a large amount of
long-term JGBs because their liabilities are also in the yen.

The stagnation of the Japanese economy has also made JGBs attractive to banks. The returns from alternative investments such as corporate loans have been low. The sustained near-zero interest rate policy of the Bank of Japan was another reason for low rates of return in general. Finally, continued deflation means that the real yields of JGBs for Japanese consumers have been higher than the nominal yields.

The regression analysis by Tokuoka (2010) finds that the low yields of JGBs may be indeed related to its ownership predominantly by Japanese residents. Table 5 shows a representative regression result. The results show that high household and corporate net savings are associated with low JGB yield. The regression results also show that high foreign ownership of the JGB is associated with high bond yield. One percentage point increase of foreign ownership of JGBs pushes up the yield by 11 basis points. When these two factors are controlled for, a standard negative relation between the debt to GDP ratio and the government bond yield re-emerges for Japan. The point estimate suggests that the bond yield rises by 2 basis points for each one percentage point increase in the debt to GDP ratio.

<Table 5> about here

5. Sustainability calculation

5.1. Basic Assumptions
5.1.1. Demography and growth

In this section, future paths of the outstanding amounts of JGBs and private asset are simulated. In the simulation, we evaluate effects of monetary policy, fiscal policy, and growth policy on the future paths of tax revenues and fiscal expenditures. Basic inputs for simulations are the future paths of growth rate, inflation rate, and consumption tax rate. The future growth rate is a function of structural policies for economic growth. Some policy makers have expressed the view that if high growth is achieved then tax increase is not necessary. Our simulations can help examining the validity of such claim. The future inflation rate is a function of monetary policy. The simulation input that we focus most is fiscal policy. Many scenarios are tested using our simulation model, including, for example, a status quo scenario, a gradual increase in consumption tax rate, and a sudden increase in consumption tax rate for the revenue side. We can entertain some alternative scenarios on the expenditure side as well.

In setting the simulation parameters, we ignore potential feedbacks from fiscal and monetary policies to growth. For example, an increase in consumption tax rate is assumed to have no impact on growth and the inflation rate. Our focus here is on the long-run growth rate, which are not likely to be influenced by policy affecting temporarily aggregate demand, such as the consumption tax increase.
Future demography is another important input for the simulation. We use the mid-point estimates (both of the birth and mortality rates) of the National Institute of Population and Social Security Research (IPSS) to generate the future age distributions. Demography influences simulation results through three channels. First, the growth potential is affected by demography. Even when the growth rate of output per worker does not change, the overall growth rate declines as the population ages and many people start retiring. Second, demographic change also influences the aggregate personal saving rate. As aging proceeds, the personal saving rate declines as more people retire and start dissaving from their financial assets. Third, pension benefits payment increases as more people retire and start receiving pensions. Because the current national pension system relies on transfers from the central government budget in addition to social security contributions, the increase in pension benefits payment increases the government expenditures.

5.1.2. Growth Rate Simulations

For the future growth rates, we consider three scenarios. The first scenario assumes the growth rate starts at 1.5% annually from 2011 to 2015 and then goes up to 2.0% from 2016 on. We call this scenario “high growth” scenario.

Although the high growth scenario is close to the one used by the Japanese government to generate various future projections, the assumption of 2% real GDP growth indefinitely is probably too optimistic given the serious challenge from aging that Japan faces. So the second and the third scenarios assume that GDP per working-age population (age 20-65) rather than GDP itself will grow at a constant rate. Letting $r_{GDP}$ and $w_{POP}$ denote the level of real GDP and the working age population respectively, we note:

$$Gr(r_{GDP}) = Gr(w_{POP}) + Gr\left(\frac{r_{GDP}}{w_{POP}}\right),$$

where $Gr(\cdot)$ is the growth rate operator: $Gr(x) = \{x(t) - x(t-1)/x(t-1)\}$. Thus, the real GDP growth rate, $\Delta r_{GDP}$, is the sum of the working-age population growth rate, $Gr(w_{POP})$ and the growth rate of real GDP per working age population.\footnote{For the IPSS population forecasts, see \url{http://www.ipss.go.jp/pp-newest/e/PPF02/top.html}}

During the rapid growth period from 1955 to 1970, the average annual growth rate was 9.7%. During the same period, the growth rate of GDP per working-age person was 7.7%. Thus, the rest

\footnote{The number of actual workers who engage in production is the working-age population times the labor participation rate, plus anyone who may be working in the retired age group (age 65 and over). The decline in working-age population can be alleviated if the participation rate increases, or more elderly participate in the labor market. This paper ignores these possibilities.}
(2.0%) came from the growth of working-age population. The positive impact of growth of working-age population on economic growth is often called demographic dividend. After the rapid growth period, growth rates of both working-age population and real GDP per working age population declined, resulting in the decline of the overall economic growth. The growth rate of GDP per working-age person, however, seems to have stabilized after the 1990s.

The second scenario assumes that the future growth rate of GDP per working age population is 1.25%, which is the average during the lost decades, 1991-2010. The overall growth rate for this case turns out to be mostly around 0%. We call this low growth scenario.

The third scenario assumes that the future growth rate of GDP per working age population is 1.93%, which was the average for the Koizumi years, 2001 to 2007. We call this mid-growth scenario.

5.2. Simulating the “Ceiling” for JGB

The future JGB to GDP ratio calculated above is compared to the amount of domestic private financial assets that can be potentially used to finance JGBs. As the measure of such domestic private savings, we consider:

Net financial assets of the household sector – Value of shares and other equities held by the household sector + Cash, deposits, government bonds, and public corporation bonds held by the private nonfinancial sector – Central government debt other than JGBs as of the end of fiscal year 2010 (such as borrowings)

Thus, we implicitly assume that the private sector will maintain the holdings of central government debt other than JGBs as of the end of fiscal year 2010. Any additional financial assets in later years can potentially be used to purchase JGBs. The private savings thus defined was 201.3% of GDP at the end of fiscal year 2010.

Starting from this initial value of the private financial assets, we assume the future private financial assets that are potentially available to finance JGBs will evolve according to:

\[
a_{t+1} = \frac{1 + r_0 + \theta(r_t - \bar{r})}{1 + \eta_t}a_t + s_t
\]

---

6 For demographic dividend in general, see Bloom, Canning, and Sevilla (2003), and for application of demographic dividend to Japan, see Komine and Kabe (2009).

7 The years 2001-2007 roughly correspond to the years when Junichiro Koizumi was the Prime Minister. Junichiro Koizumi became Prime Minister in April 2001. He resigned as Prime Minister in September 2006.

8 The data on the financial assets are taken from the Bank of Japan Flow of Funds Data. The data on the central government debt other than JGBs come from the Ministry of Finance (http://www.mof.go.jp/jgbs/reference/gbb/2303.html).
where $a_t$ is the private financial assets to GDP ratio at the beginning of time $t$ and $s_t$ is the (flow) saving from non-interest income divided by GDP in year $t$. As the interest rate, $r_t$, increases, the interest income increases. Thus, if we assumed that the interest income is fully reinvested, the financial assets available to finance government debts would grow faster as the interest rate rises even when the interest rate increase is a result of concern on the sustainability of the government debt. In other words, when investors require higher yields on government bonds to compensate for higher default risk, it increases the amount of financial assets that can be potentially used to buy more government bonds. To avoid this counter-intuitive implications, we assume that only a proportion $\theta$ of the interest income that exceeds the initial level of the interest income $(r_t - r_0)a_t$ is reinvested to increase the financial assets. Under this assumption, the private sector financial assets grow by $\frac{1 + r_t + \theta(r_t - r_0)}{1 + \eta_t}a_t$ in year $t$ through reinvestment. The new saving ($s_t$) is then added to get to the new level of financial assets at $t+1$.

For the value of $\theta$, we consider three cases. At one extreme we consider the case where the private sector reinvests all the interest income ($\theta = 1$). The other extreme we consider is that no interest income that exceeds the initial level is reinvested ($\theta = 0$). As an intermediate case, we consider $\theta = 0.5$.

The aggregate saving rate is a function of the demography. Appendix describes how we estimate the aggregate saving rate from 2010 to 2050. The result is shown in Figure 6. The saving rate starts out above 3% in 2010, but quickly goes below 2% by 2017. It then holds steady and start to decline again in the 2030s, falling almost to -3% by the end of the 2040s.

The upper-bound for the JGB to GDP ratio is defined as the level when the new issue of JGB exceeds the total (flow) saving of that year and the amount of the available private sector financial assets that are not in the form of the JGBs yet. Thus, in order to avoid the upper bound, the new issue of JGB must satisfy the following constraint.

\[
B_t - B_{t-1} \leq S_{t-1} + (A_{t-1} - B_{t-1})
\]

where $B$, $S$, and $A$ denote the levels of JGBs, total private saving, and the private sector financial assets available for JGBs respectively, not normalized by GDP. Or rewriting this in terms of the ratios to GDP,

\[
b_t \leq \frac{s_{t-1} + a_{t-1}}{1 + \eta_{t-1}}
\]
5.3. Tax Revenues

We estimate the future path of government revenues by estimating each component of government revenues as a function of various macroeconomic variables.

5.3.1. Consumption tax

Consumption tax is a value added tax. An exemption is very limited, so that the change in consumption tax revenues is expected to be roughly proportional to the change in nominal GDP times the consumption tax rate ($V_{rate}$). Hence we estimate the consumption tax revenue for each future year, $Tax_V$, as a function of $V_{rate}$ times nominal GDP, $NGDP$. The sample period for estimation is from 1990 to 2011. Since the consumption tax was introduced in 1989, the sample period is bound to be short. The estimated regression is:

$$Tax_V = 0.031 + 0.384 \times (V_{rate} \times NGDP) - 33.143 \times \text{inflation}$$

(0.395) (0.019) (7.63)

where standard effort is shown in the bracket. The adjusted R-squared of 0.98. Both $V_{rate} \times NGDP$ and inflation are statistically significant at 1% level. The coefficient on $V_{rate} \times NGDP$ means that for 500 trillion yen economy, one percentage point increase in consumption tax rate would generate about 2 trillion yen consumption tax revenue. It is not clear why an increase in the inflation rate reduces the consumption tax, but we leave the term in the regression because it is highly significant.

In the simulations below, we take the coefficient estimates from this regression and predict future consumption tax for exogenously given future growth and inflation.

5.3.2. Personal Income Tax

The personal income tax revenue seems to be more sensitive to economic fluctuations as shown in Figure 4. The personal income tax is levied on all personal income including salary and wages, personal business income, capital gains and other incomes (such as rental revenue). Salary, wages, and personal business income are expected to be correlated with nominal GDP, and capital gains are expected to be correlated with the movement of stock prices. The following specification is used to estimate parameters for simulation.

$$\ln(Tax_I) = -3.657 + 0.5324 \times \ln(NGDP) + 0.3364 \times \ln(Nikkei) + 4.3633 \times \text{Inflation},$$

(0.7543) (0.1780) (0.0672) (2.0695)

where standard errors are in the bracket. Sample period is from 1978 to 2011. Both NGDP and stock prices significantly increase income tax revenues. In addition, inflation also increases the tax revenue.
This reflects a well-known bracket creep during the inflation.

5.3.3. Corporate Income Tax

The corporate tax revenue is also expected to be a function of GDP and stock prices. The particular specification that had a better fit is as follows:

\[
\ln(TaxC) = -3.501 + 4.166 \times \ln(NGDP) - 3.748 \times \ln(NGDP(t-1)) + 0.351 \times \ln(Nikkei)
\]

\[
(0.826) \quad (1.575) \quad (1.362) \quad (0.086)
\]

Standard errors are in the bracket. The sample period is from 1978 to 2011. The presence of lagged GDP in the regression may reflect the loss carry-over widely allowed for corporate accounting.

5.3.4. Other Revenues

The other tax revenues and other non-tax revenues are difficult to model. It also has large jumps in the last three years. This may reflect two factors. The budget in fiscal year 2008 (ending March 2009) had large supplementary budgets in response to large declines in economic activity in the wake of global financial crisis. The increased budget in 2009 reflects the continuation of crisis responses. In order to finance the increased expenditures, surpluses in some special accounts were transferred to the general account as other revenues. In the fall of 2009, the Democratic Party of Japan (DPJ) came into power, with a platform of more government spending without tax increases. The DPJ government continued to siphon surpluses in special accounts into the general budget to fund their pet projects like cash for children and income support for all farmers. Major sources of these transfers included FILP Special Account (4.24 trillion yen in fiscal 2009, 4.78 trillion yen in fiscal 2010, and 1.06 trillion yen in fiscal 2011) and Special Account for Foreign Exchange Fund (2.85 trillion yen in 2010). These transfers between special accounts and general account would not matter if we conducted the analysis at the general government level. Because this paper focuses on the general account of central government, it matters.

In light of these observations, we estimated the following regression.

\[
\ln(OtherRev) = -3.303 + 0.784 \times \ln(NGDP) + 0.126 \times \ln(Nikkei) + 0.391 \times \text{Dummy}
\]

\[
(0.422) \quad (0.101) \quad (0.065) \quad (0.089)
\]

Standard errors are in the brackets, and the sample period is 1975 to 2011. The sum of other tax revenues and other non-tax revenues respond positively to NGDP and the stock price index. The regression includes the dummy variable that takes one for fiscal years 2009, 2010, and 2011 to account for the transfers of surpluses from special accounts.

5.3.5. Estimation of Nikkei price index

---

9 Bank of Tokyo Mitsubishi UFJ Treasury and Investment Division (2012, P.148)
Stock prices are financial variables that are difficult to predict from macroeconomic data. For our simulations, we estimate the Nikkei price index as a function of nominal GDP growth rate. We have also experimented with other macro variables such as the interest rate, but none that we tried enter the regression significantly. Thus, we use:

$$\text{Gr(nikkei)} = 0.135 + 2.290 \times \text{Gr(NGDP)}$$

(0.047) (1.043)

Standard errors are in brackets and the sample period was from 1978 to 2010.

5.4. Expenditures

5.4.1. Social Security related expenditures

On the expenditure side, the critical components are social security related expenditures (SS) and the debt payment expenditures (DebtPay). The former is expected to increase with the increase in the number of retired people. More elderly people require higher expenditure on pension benefits, medical care, and long-term care. Although social security has some special accounts and funds that had been accumulated reserves for the adverse demographic change, expenditure out of the general account has been an integral part of the Japanese social security system. Thus, we estimate the following regression.

$$\ln(\text{SS}) = -2.059 + 0.050 \times \text{OldRatio} + 0.653 \times \ln(\text{NGDP}) + 0.243 \times \text{Dummy},$$

(0.343) (0.006) (0.068) (0.073)

where OldRatio is the proportion of the people older than 65 years old in the population. Standard errors are in the brackets and the sample period is from 1975 to 2010. The estimated results show that the increase in the old-age population puts upward pressure on the social security expenditures and an increase in the nominal GDP also increases the social security expenditures. Dummy is a variable that takes 1 for 2009-2012, and 0 for the earlier years, in order to address a sudden increase in budget under the DPJ government.

5.4.2. Debt Service Expenditure

The debt service payments in the general account consist of two components: interest payments on existing JGB and transfers to the Special Account for JGB Amortization (Kokusai Seiri Kikin Tokubetsu Kaikei). Estimating the first part is straightforward. We assume DebyPay is an increasing function of the average interest rate on the existing JGBs multiplied by the JGB outstanding in each year, JGBInterest. The interest payment is approximated by the sum of the past issues of JGB times the average 10 year interest rate in the past 10 years (t-1 to t-10). This approximation assumes that all issues are ten-year fixed rate bonds.

Estimating the transfers to the special account can be a bit more involved. JGBs are issued on
the premise that they will be redeemed in 60 years. Thus, one-sixtieth of the existing JGBs is required to be transferred to the JGB amortization fund. When the general account falls into large deficits, however, the required transfer was occasionally suspended. For our simulation, we gross over these details and just assume the transfer is proportional to the amount of JGB at the end of the previous year. The regression result is given by:

\[
\text{DebtPay} = 1.238 \times \text{JGBInterest} + 0.020 \times \text{JGB}(t - 1)
\]

Standard errors are in brackets and the sample period is from 1985 to 2010. We note the coefficient estimate on JGBInterest is greater than one, suggesting that we may be underestimating the interest rate. For the coefficient estimate on the lagged JGB, it is close to 1/60 (0.016), which is the required rate of transfer.

5.4.3. Transfers to Local Government

Transfers to local government are another big expenditure item. It has an increasing trend, similar to social security expenditure. The transfer from the central government is a significant source of income for local governments, which are responsible in providing their residents with healthcare, educational, recreational and other services. In addition, redemption of local government bonds is made out of the transfers. The past data shows that the growth of transfers to local governments outpaced the growth of GDP as shown in the following regression.

\[
\ln(\text{LOC}) = -4.941 + 1.238 \times \ln(\text{NGDP})
\]

Standard errors are in brackets, and the sample period is from 1975 to 2010. Unless the fiscal relationship between the central government and local governments changes fundamentally, the transfers to local governments will continue to grow faster than nominal GDP.

5.4.4. Other expenditures

Other major expenditure categories are public works, defense and education and science. As shown in Figure 3, these expenditures increased in the 1980s, and became steady or slightly declined in the 1990s and 2000s. The movements seem to be proportional to the movement of nominal GDP. Hence, the following specification is used.

\[
\ln(\text{OtherExpend}) = -0.710 + 0.669\ln(\text{NGDP})
\]
Here OtherExpend includes all the expenditure categories other than debt service, social security related expenditure, and transfers to local governments. Standard errors are in brackets, and the sample period was from 1975 to 2010. The regression result suggests that these expenditures grow at a slower pace than nominal GDP.

5.5. Simulating the Future Path of JGB

The outstanding amount of JGB of year t is the sum of the JGB at t-1 and the new issues of JGB during year t. The new issues of JGB are determined as the difference between central government expenditure, which includes interest payments on JGBs, and central government revenues, most of which are taxes.

Once we set the future paths of nominal GDP, inflation, and consumption tax rate, the regression models above can be used to estimate all revenue and expenditure categories in the future. We use the inflation rate measured in GDP deflator, and its future values are assumed to be -1% in 2012 and 2013, 0% in 2014, and 1% in 2015 and on. The inflation rate measured in the GDP deflator is about 1 percentage point lower than the inflation rate measure in CPI. Hence, the assumption of the 1% inflation in GDP inflation amounts to the 2% CPI inflation rate: the rate targeted by the Bank of Japan since January 22, 2013.

We have three scenarios for the GDP growth rate as explained in 5.1.2. High growth scenario assumes 2% real GDP growth and 3% nominal GDP growth. Mid-growth scenario assumes 1.9% growth of real GDP per working population. Low growth scenario assumes 1.25% growth of real GDP per working population.

For the future consumption tax increases, we consider two scenarios. In the first scenario called “status quo,” the consumption tax rate is raised to 8% in April 2014 and to 10% in October 2015, but it is kept at 10% after 2015. The second scenario called “gradual increase” starts out the same way as the “status quo,” but the consumption tax rate continues to rise even after 2015 by 1 percentage point annually until the rate reaches 25% in 2030. Then, the rate is kept at 25% indefinitely.

5.6. Simulation

5.6.1 Crash—when the JGB amount breaks the ceiling

If the growth of private sector financial assets decelerates and the government debt continues to increase, the amount of government debt will eventually exceed the amount of private sector financial assets. At that point, even if all the private sector financial assets are invested in the JGBs,
leaving nothing for private sector credit, at least some JGBs must be held by foreign investors. As soon as the market sees that the current course leads to such a situation, the government will have trouble selling new JGBs at low interest rates. In this paper, we call such a situation a “JGB crisis.” In a JGB crisis, new JGBs cannot be sold at low interest rates and the interest rate has to rise. If the current fiscal situation continues, will the amount of JGB eventually break the ceiling? What kind of fiscal consolidation will be sufficient to prevent a JGB crisis? We can ask these questions using the simulation model described above.

Figure 7 shows the future path of JGB under high growth scenario and status quo consumption tax scenario. The JGB breaks the ceiling as early as 2023 or 2024. The exact timing depends on the value of $\theta$. However, there is no mistake in having a runaway in case of $\theta=0$, which is the case where no interest income is reinvested into new JGBs. Even in the case of $\theta=1$, where the interest income is fully invested into new JGBs, a JGB crisis will happen by 2042. It seems that high growth alone would not solve the fiscal sustainability problem. Tax hike, expenditure cut, or both seems to be necessary.

Figure 7 about here

Figure 8 is the result under the gradual increase scenario for consumption tax. The growth scenario is still high growth. In this case, the JGB/NGDP ratio will peak in 2023 and start to decline. The ceiling is always above the JGB/NGDP ratio, regardless the value for theta. This is the case of fiscal sustainability. If the government succeeds in stimulating economic growth, with policies other than expenditure increases or tax cut, the gradual increases in the consumption tax, up to the European level of 25%, by one percentage point hike a year.

Figure 8 about here

Figure 9 is the simulated path for JGB/NGDP ratio under the mid-growth scenario. The scenario assumes that the consumption tax rate will be raised gradually to 25%. The JGB crisis will happen in this case. The JGB hit the ceiling between 2023 (in case of theta=1) and 2029 (in case of theta=0). Although the JGB/GDP ratio stayed at around 200% from mid-2020s to late 2030s, it will start to rise after 2040. The per-worker productivity growth rate is set to the one comparable to that in the Koizumi years—the best 5 years during the two decades of the slow growth. The simulation shows that it is not enough to avoid the crisis, unless the consumption tax stays at 10% after 2015.

Figure 9 about here

Figure 10 show the path of the JGB/NGDP ratio under the low growth scenario. The consumption tax rate scenario is still “gradually increase.” In this case, the JGB/NGDP path shows the monotone increases throughout the simulation period. It will reach the crisis point in 2022 (if theta is 1.0), 2024 (if theta is 0.5), or 2029 (if theta is 0.09).

Figure 10 about here

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10 Almost all recent papers on Japanese government debt reach the same conclusion: the current course of fiscal debt dynamics is not sustainable. Imrohoroğlu and Sudo (2011) find that an unlikely large jump in productivity growth would be necessary to stabilize the debt to GDP ratio without changing fiscal policy.
In sum, the fiscal crisis is not avoidable even in the case of high growth (2.0%), but no tax increase, as shown in Figure 7), or tax increases (up to 25%) but low growth (around 0%), as shown in Figure 10. In order to avoid the crisis, the Japanese government has to achieve both high growth and high tax, as shown in Figure 8.

6. Consequences of a JGB crisis

This paper explored different paths of the JGB/GDP ratio for different sets of assumptions. We showed that without consumption tax hike beyond what the Japanese government already plans, a JGB crisis will eventually happen even with 2% real GDP growth. Steadily increasing the consumption tax rate by 1% a year until 25% consumption tax rate is reached, Japanese government seems to be able to avoid a JGB crisis if the GDP growth rate is reasonably high.

If and when the fiscal crisis occurs, how will the crisis evolve? First, the rise in JGB yields will raise other interest rates, such as the mortgage rate and corporate bond rate, and increase the cost of funds for households, firms and banks. This will reduce the consumption of non-durables and durables at least temporarily, and hurt corporate investment. The magnitude of the impacts on consumption and investment, however, may not be large. Muellbauer and Murata (2011), for example, find that consumption in Japan did not increase at all when the interest rate fell during the 1990s and 2000s. They even find that consumption responded positively to a rise in the interest rate in some specifications. Similarly, many large corporations have substantial corporate saving and do not feel constrained by the cost of funds. Small and medium firms that have been helped by the low interest rate environment and forgiving lending attitude by banks under the Act to Facilitate Financing for SMEs may suffer from higher cost of funds.

Second, the JGB crisis would have a large adverse impact on financial institutions, because the majority of long-term government bonds are held by Japanese banks and insurance companies. Worse, many banks hold almost all their JGBs as securities available for sales. When the interest rate rises, they suffer valuation losses. For example, Japanese banks collectively hold about 142 trillion yen of central and local government bonds as of the end of March 2010. This is about 32% of total bank loans. According to Bank of Japan (2010), 100 basis points increase in JGB yields is estimated to cause about 4.7 trillion yen of losses for Japanese banks collectively (BOJ 2010, Chart 3-2-3, p.39). This is about 11.7% of the Tier I capital at the end of March 2010 and about twice as much as the income before tax for the accounting year ending on March 31, 2010. The interest rate risk as of March 2008 was estimated to be around 3.5 trillion yen. This may not reduce regulatory capital immediately because the banks are not required to mark the JGBs to the market in calculating their capital ratios if the JGBs have unrealized capital losses, but many will nonetheless tighten their credit provision.

Third, if the short-term interest rate rises sharply, along with the long-term bond rate, this
would cause another serious problem. The foreign exchange special account is where most of foreign reserves are held. On the asset side of the special account, U.S. Treasuries are held as international foreign reserves; and on the liability side of the special account, short-term government securities (FBs) are issued to the market. In the last 20 years, the interest rate of the U.S. treasuries exceeded the short-term yen interest rate. However, if the yen interest rate becomes higher than the U.S. interest rate, the difference incurs the cash flow from the regular budget to the special account. Ito (2003) showed how much profit the Japanese authority made from the interest rate differential between the U.S. and Japan. The size of FBs outstanding is about 110 trillion yen. If the yen interest rate becomes higher than the dollar interest rate by 2 percentage points, it would require 2 trillion yen of interest income subsidy from the general account to the special account.

Finally, the JGB crisis is likely to force the government to respond. Here we list some likely responses of the government and the central bank. First, to the extent that the government still has room for tax increases when the crisis happens, the government can implement emergency tax increases. That may impress the market and the yield may come down. Since it takes time for the JGB to GDP ratio to come down, however, the reduction in the yield may be very limited. Thus, a drastic tax hike alone may not be sufficient to end the crisis anymore. Even worse, the higher tax rate may further depress the aggregate demand, resulting in actually lower tax revenue. Whether the tax increases save the economy or destroy the economy depends on some factors that this paper does not consider, such as the elasticity of the aggregate demand to a tax increase.

Second, the government is likely to be forced to cut expenditures as well. Because a substantial part of the increase of government expenditure in recent years and in the near future comes from the increased liability of the national pension system and the healthcare system, cuts in these areas would have maximum impacts financially. Cutting the benefits of retirees is in the direction toward correcting the intergenerational imbalance that currently exists in the public transfers. For example, Keen, Pradhan, Kang, and de Mooij (2011) find “those over age 60 as of 2003 are expected to receive about 100 million yen more in net social benefits over their lifetime than are those not yet born” (p.16).

Third, the government may try to force domestic financial institutions to roll over the debt or to accept restructuring of the debt. The government may be especially effective in arranging such a deal with the Japan Post Bank, which is still owned by the government and is a large holder of the government bonds. The forced restructuring, however, will impose losses on the financial institutions and may cause a financial crisis.

Fourth, instead of negotiating with the private sector financial institutions, the government may pressure the Bank of Japan to buy government bonds, including newly issued bonds. The Bank of Japan has been clear that they do not endorse such a monetization policy because it undermines the fiscal discipline. However, at the time of crisis, the central bank may find monetization the least destructive option. If such money financing is used to respond to the liquidity crisis, it will lead to very high inflation, which will sharply depreciate the yen. This will
partially stimulate the economy via an export boom, provided that Japan does not suffer a major banking crisis at the same time.

Unexpected inflation will result in the redistribution of wealth from lenders to borrowers. This is also redistribution from the old generations to young generations, since the older generation has much higher financial assets whose value might decline. However, this may not have such detrimental impacts on the economy, since many who participate in production and innovation (corporations and entrepreneurs) are borrowers rather than lenders.
References


Appendix. Estimation of aggregate saving rate: 2010-2050

Let $s_{it}$ be the saving per capita in year $t$ for the generation who were born at year $i$. The aggregate saving in year $t$ is given by:

$$S_t = \sum_{i=0}^t N_{it} s_{it},$$

where $N_{it}$ is the number of people who were born at year $i$. Thus, the aggregate saving to GDP ratio is:

$$\frac{S_t}{Y_t} = \frac{\sum_{i=0}^t N_{it} s_{it}}{Y_t / N_t} = \sum_{i=0}^t \frac{N_{it}}{N_t} \theta_{it},$$

where $\theta_{it} = \frac{s_{it}}{Y_t / N_t}$.

Thus, the aggregate saving rate is the weighted average of the generational saving rate measured as the saving per capita divided by GDP per capita, which we denote as $\theta_{it}$.

If we have $\theta_{it}$ and $N_{it}/N_t$, we can calculate the aggregate saving rate for year $t$.

We use the data from *Family Income and Expenditure Survey* to calculate the saving rate for each age bracket. The survey reports the income and expenditure for 11 age brackets according to the age of the head of the household: 24 or younger, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70 or older. The survey covers a sample of households with two or more members. Thus the survey does not cover single households. The income and expenditure items are collected for the sample of households whose heads are employees, but only expenditure items are collected for all other households, which include not only retirees but also self-employed. Using the tabulation for all the households and another tabulation for the employee households only, we construct the saving rate in the following way.

First, we estimate the number of households headed by retirees and the number of households headed by non-employees (self-employed, farmers, etc.). We have the following information from the survey for each age bracket.

$N_t$: Total number of all types of households in the sample
HT: Average number of household members for all types of households
WT: Average number of household members who earn income for all types of households
NE: Total number of employee households in the sample
HE: Average number of household members for employee households
WE: Average number of household members who earn income for employee households

Let NR be the number of retiree households and NS be the number of the other households (self-employed and others). Assuming the proportion of the household members who earn income is the same for both employee households and other households, but zero for retiree households, we know:

\[(N_E + N_S) \frac{W_E}{H_E} = N_T \frac{W_T}{H_T}, \text{ and}\]
\[N_E + N_S + N_R = N_T\]

By solving these, we can calculate NS and NR.

Next, we calculate the per capita income for each generation by multiplying the average household income for employee households by NE+NS. The assumption here is that the average income is the same for both employee households and other non-retiree households. The consumption for each generation is calculated by multiplying the average consumption for all households by the number of all sample households.

Finally, the saving is calculated by subtracting consumption from income for each age bracket. We estimate the number of people covered by the survey by multiplying the number of all households and the average number of household members. The saving per capita is calculated by dividing the saving by this estimated number of people in the survey. The saving rate relative to GDP per capita is calculated by dividing the saving for each age bracket by the average income per capita. The saving rate for each age bracket calculated in this way for each year from 2000 to
2010. The number for each age bracket did not change very much over the decade. We take the average saving rate for each age bracket over 2000-2010 interval and use that as $\theta_t$ for $t \in [2010, 2050]$.

The population weight for each generation is calculated from the mid-point projection by the National Institute of Population and Social Security Research (IPSS).
### Table 1  Different concepts of Government liabilities

<table>
<thead>
<tr>
<th>Panel A</th>
<th>Panel B</th>
<th>Panel C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>National Liabilities: JGB, Borrowings and Guarantees as reported to IMF</strong></td>
<td><strong>National and Local Government Longterm liability (to be redeemed by mainly future</strong></td>
<td><strong>General Government Gross Liability (National Account concept)</strong></td>
</tr>
<tr>
<td>At the end of March 2011</td>
<td>Forecast for March 2012</td>
<td>End of March 2010</td>
</tr>
<tr>
<td>(Trillion yen)</td>
<td>(Trillion yen)</td>
<td>(Trillion yen)</td>
</tr>
<tr>
<td>GDP</td>
<td>GDP</td>
<td>GDP</td>
</tr>
<tr>
<td>JGB</td>
<td>JGB</td>
<td>JGB (+)</td>
</tr>
<tr>
<td>Zaito Bonds</td>
<td>Zaito Bonds (**)</td>
<td>Zaito Bonds</td>
</tr>
<tr>
<td>Others(*)</td>
<td>Others (*)</td>
<td>Not included</td>
</tr>
<tr>
<td>Financing Bills (**)</td>
<td>Financing Bills (**)</td>
<td>Not included</td>
</tr>
<tr>
<td>Government guarantee</td>
<td>Government Guarantee</td>
<td>Not included</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>969.1</td>
<td>892.0</td>
<td>1,023</td>
</tr>
<tr>
<td>202%</td>
<td>186%</td>
<td>214%</td>
</tr>
<tr>
<td>GDP(2010)</td>
<td>479.0</td>
<td></td>
</tr>
</tbody>
</table>


(*) Others includes government bonds that are issues as capital of public entities (Kofu Kokusai) and borrowings

(**) Financing Bills are issued primarily to fund the foreign reserves that are held in the special account of the government. They are rolled over every 3 months, and considered to be short-term liabilities that have assets, that is foreign reserves, to match the liabilities. FBs should be excluded from long-term liabilities, and from “net” government liabilities.

(*** Zaito bonds are not included because they are in theory repaid from income from government investment. Financing bills are not included because they are short-term, and also they are backed by assets (foreign reserves); and guarantee is not included because they are only contingent liabilities.

(****) Government guarantee includes liabilities at the public agencies (Dokuritsu Gyosei Hojin)


(*) Borrowings for accounts to be distributed to local governments (Kofu tax), about 34 trillion yen, is categorized in the local liabilities instead of National government liabilities

(**) Short-term discount bonds are excluded from JGB and included in Financing bills and discount bonds

(*** Others include borrowings for accounts to be distributed to local governments (Kofu tax), about 34 trillion yen.

(****) Government guarantee includes liabilities at the public agencies (Dokuritsu Gyosei Hojin)
### Table 2  Cumulative Expenditure Excess of the 1991 Level

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Cumulative Excess Expenditure: 1992-2010 (trillion yen)</th>
<th>% of Total Cumulative Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Security</td>
<td>126.9</td>
<td>31.27%</td>
</tr>
<tr>
<td>Education and Culture</td>
<td>12.3</td>
<td>3.02%</td>
</tr>
<tr>
<td>Debt Interest Payments</td>
<td>28.5</td>
<td>7.03%</td>
</tr>
<tr>
<td>Transfer to Local Gov't</td>
<td>-6.7</td>
<td>-1.64%</td>
</tr>
<tr>
<td>Public Works</td>
<td>56.3</td>
<td>13.87%</td>
</tr>
<tr>
<td>Defense Spending</td>
<td>7.1</td>
<td>1.76%</td>
</tr>
<tr>
<td>Others</td>
<td>16.0</td>
<td>3.94%</td>
</tr>
<tr>
<td>Total Expenditure</td>
<td>240.4</td>
<td>59.25%</td>
</tr>
</tbody>
</table>
### Table 3  Cumulative Revenue Shortage Compared with the 1991 Level

<table>
<thead>
<tr>
<th>Revenue Category</th>
<th>Cumulative Revenue Shortage: 1992-2010 (Trillion Yen)</th>
<th>% of Total Cumulative Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income Tax</td>
<td>-183.3</td>
<td>45.18%</td>
</tr>
<tr>
<td>Corporate Tax</td>
<td>-92.0</td>
<td>22.67%</td>
</tr>
<tr>
<td>Consumption Tax</td>
<td>73.3</td>
<td>-18.06%</td>
</tr>
<tr>
<td>Other Tax Revenue</td>
<td>-9.3</td>
<td>2.28%</td>
</tr>
<tr>
<td>Other Revenues</td>
<td>45.9</td>
<td>-11.31%</td>
</tr>
<tr>
<td>Total Revenue (Excluding Bond Issues)</td>
<td>-165.3</td>
<td>40.75%</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>General Government</strong></td>
<td>2.0 0.3%</td>
<td>7.4 1.1%</td>
</tr>
<tr>
<td><strong>Public Pension</strong></td>
<td>57.6 9.0%</td>
<td>61.5 9.2%</td>
</tr>
<tr>
<td><strong>FILP</strong></td>
<td>48.8 7.6%</td>
<td>39.4 5.9%</td>
</tr>
<tr>
<td><strong>Postal Saving</strong></td>
<td>109.7 17.1%</td>
<td>126.2 18.9%</td>
</tr>
<tr>
<td><strong>Postal Insurance</strong></td>
<td>55.1 8.6%</td>
<td>57.0 8.5%</td>
</tr>
<tr>
<td><strong>Bank of Japan</strong></td>
<td>92.1 14.3%</td>
<td>86.7 13.0%</td>
</tr>
<tr>
<td><strong>Private Financial Institutions</strong></td>
<td>218.6 34.1%</td>
<td>218.5 32.7%</td>
</tr>
<tr>
<td>banks</td>
<td>111.6 17.4%</td>
<td>114.5 17.2%</td>
</tr>
<tr>
<td>insurance</td>
<td>54.8 8.5%</td>
<td>58.4 8.7%</td>
</tr>
<tr>
<td>private pension funds</td>
<td>21.3 3.3%</td>
<td>24.0 3.6%</td>
</tr>
<tr>
<td>others</td>
<td>31.0 4.8%</td>
<td>21.6 3.2%</td>
</tr>
<tr>
<td>Overseas</td>
<td>26.4 4.1%</td>
<td>30.2 4.5%</td>
</tr>
<tr>
<td>Household</td>
<td>21.8 3.4%</td>
<td>28.0 4.2%</td>
</tr>
<tr>
<td>Others</td>
<td>9.6 1.5%</td>
<td>12.4 1.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>641.8100.0%</td>
<td>667.3100.0%</td>
</tr>
</tbody>
</table>
Table 5: Explaining the JGB yield

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gross debt including FILP</th>
<th>JGB held by Bank of Japan</th>
<th>Net financial wealth held by household and corporate sectors</th>
<th>Share of foreign holdings of JGBs</th>
<th>R square</th>
</tr>
</thead>
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<td>Estimate</td>
<td>0.02</td>
<td>0.01</td>
<td>-0.02</td>
<td>0.11</td>
<td>0.38</td>
</tr>
<tr>
<td>t-stat</td>
<td>(3.52)**</td>
<td>(0.36)</td>
<td>(-3.37)**</td>
<td>(2.06)**</td>
<td></td>
</tr>
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</table>

Tokuoka (2010) Table II.6
Notes: FILP is the government investment program, which used to be in the special account that were funded by Postal Bank surplus funds, and later became a part of government bond issues.
Fig.1. Central Government Budget: Expenditure, Tax, and Debt Issues

Note:
(1) Final budget.
(2) Ad-hoc deficit-financing bonds (approx. 1 trillion yen) were issued in FY1990 as a source of funds to support peace and reconstruction efforts in the Persian Gulf Region.
(3) Reconstruction bonds are issued in FY2011, which are used as a temporary means until the financial resources are secured by the revenues including the special tax for reconstruction. Measures and for reconstruction from the Great East Japan Earthquake, expected to be implemented within the first five years (FY2011-2015), would be financed by reconstruction bonds issuance.

Fig. 2. JGBs, Outstanding Balance

Note: (1) Actual budget.
(2) Special Deficit-financing bonds outstanding include refunding bonds for long-term debts transferred from JR Settlement Corporation, the National Forest Service, etc., Ad-hoc Special Deficit-financing bonds, Tax reduction-related Special Deficit-financing bonds and Pension-related Special Deficit-financing bonds.
(3) Government Bonds Outstanding includes reconstruction bonds issued (FY2011: in General Account, after FY2012: in Special Account for Reconstruction from the Great East Japan Earthquake) as a source of funds to implement the measures for the reconstruction from the Great East Japan Earthquake in FY2011 (10.7 trillion yen).

Fig. 4: Trends in tax revenue, by tax item

(Note) Figures up to FY2011 are settled accounts, and those for FY2012 are budgeted accounts.
Fig. 5 Trends in Interest Payments and Interest Rate

(trillion yen, %)

- JGB Outstanding (right scale)
- Interest rate (left scale)
- Interest Payments (left scale)

Note: (1) Interest Payments: Settlement budget. JGB outstanding: Actual budget.
(2) JGB Outstanding includes reconstruction bonds issued in FY 2011 (10.7 trillion yen). Measures and projects for reconstruction from the Great East Japan Earthquake would be financed by reconstruction bonds, which are used as a temporary means until when the financial resources are secured by the revenues including the special tax for reconstruction.

Figure 6: Aggregate Saving to GDP Ratio: 2010-2050
Figure 7: High growth and Status Quo
Figure 8: High growth and Consumption tax hike
Figure 9: Moderate growth and consumption tax hike
Figure 10: Low growth and consumption tax hike