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Optimal fiscal policy rule for achieving fiscal sustainability: A Japanese case study

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ADB Working Paper Series

**Optimal Fiscal Policy Rule for Achieving Fiscal Sustainability:
A Japanese Case Study**

Naoyuki Yoshino, Tetsuro Mizoguchi,
and Farhad Taghizadeh-Hesary

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Abstract

Japan's debt-to-gross domestic product (GDP) ratio is the highest among Organisation for Economic Co-operation and Development (OECD) countries. This paper will firstly answer the question of whether Japanese government debt is sustainable. Next, while the Domar condition and Bohn's condition are often used in the literature to check whether a government's debt situation is in a dangerous zone, this paper will show that the Domar condition is obtained only from the government budget constraint (namely the supply of government bonds) and does not take into account the demand for government bonds. A simple comparison of the interest rate and the growth rate of an economy using the Domar condition is not adequate to check the stability of a government's budget deficit. Both the interest rate and the growth rate of the economy are determined endogenously in the model. Thirdly, this paper shows that Bohn's condition satisfies the stability of the government budget in the long run by imposing constraints on the primary balance. However, Bohn's condition does not achieve economic stability—even if the condition is satisfied, the recovery of the economy may not be achieved. This paper will propose a new condition that satisfies both the stability of the government budget and the recovery of the economy. The paper will shed light on these issues both theoretically and empirically. The empirical findings declare that in order to achieve fiscal sustainability based on the optimal fiscal policy rule provided in this paper, both sides of the Japanese government budget (expenditure and revenue) need to be adjusted simultaneously. Moreover, the results show that the decrease in government expenditure has to be more than the increase in tax revenue.

JEL Classification: E42, E63

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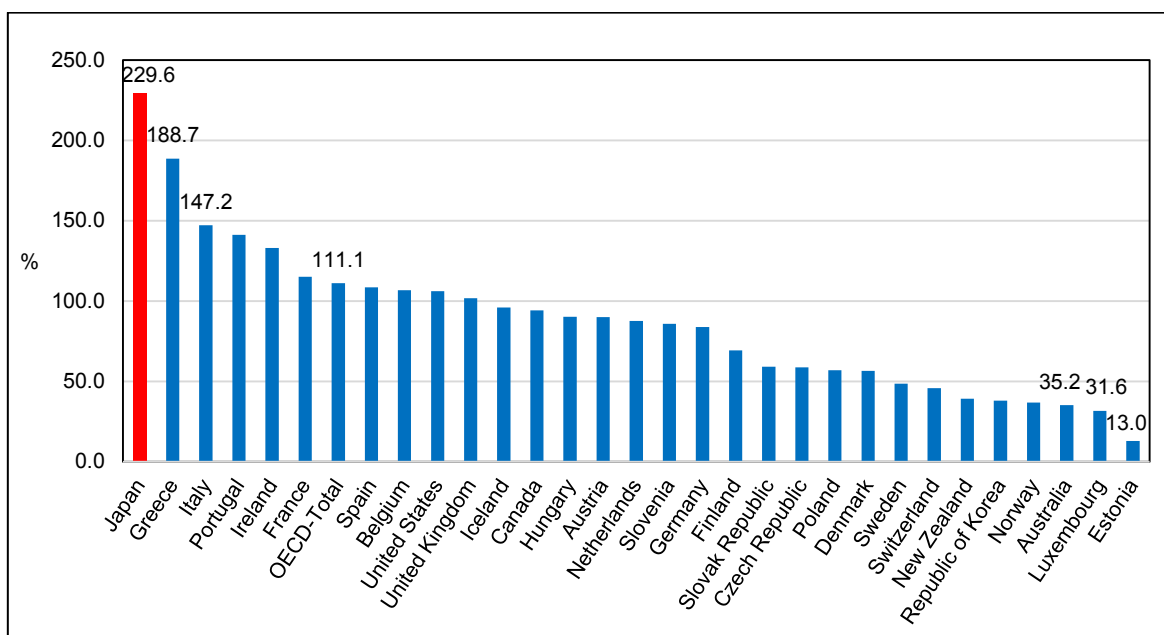
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1. INTRODUCTION AND AN OVERVIEW OF THE JAPANESE BOND MARKET

Japan’s debt-to-gross domestic product (GDP) ratio is the highest among Organisation for Economic Co-operation and Development (OECD) countries, at more than 220% (Figure 1). The interesting point is that Japan’s debt is still sustainable, while the southern European countries Greece and Cyprus went bankrupt due to having government deficits that were high, although their debt-to-GDP ratios were lower compared to Japan’s.

Figure 1 illustrates the general government gross financial liabilities as a percentage of GDP for selected OECD countries. It is clear that the ratio for Japan is the highest, at 229.6% in 2014. After Japan, Greece and Italy have the second and third highest levels at 188.7% and 147.2%, respectively. The average gross debt-to-GDP ratio for all OECD countries is 111.1%. Estonia has the lowest ratio among OECD countries, at 13%.

Figure 1: Gross Debt/Gross Domestic Product in Selected OECD Countries, 2014



OECD = Organisation for Economic Co-operation and Development.

Note: General government gross financial liabilities as a percentage of GDP.

Source: OECD Economic Outlook No. 95 database (2014).

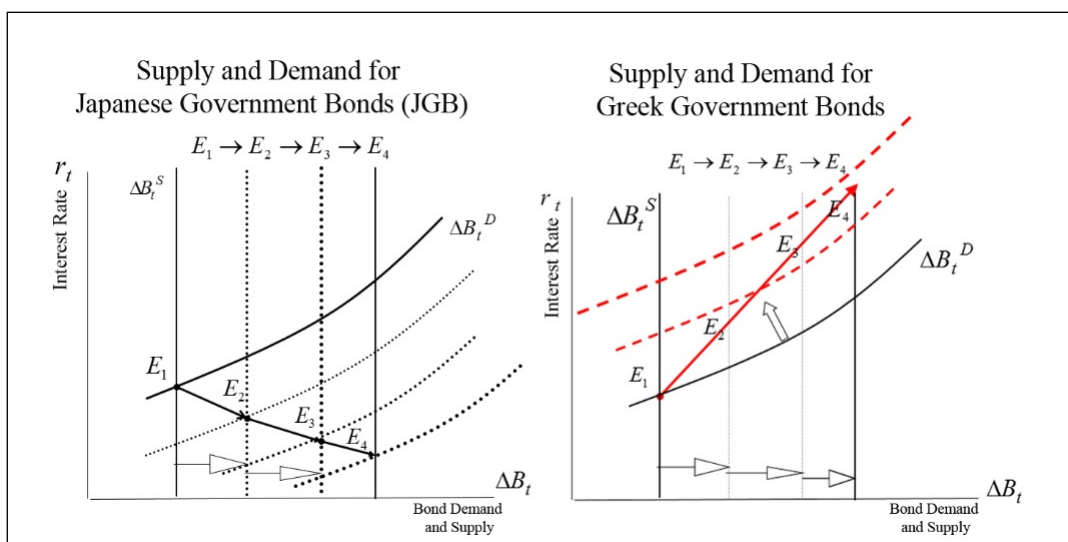
Accumulated government debt in Japan now amounts to more than 220% of GDP and it will be difficult to issue further bonds unless the Bank of Japan purchases Japanese government bonds (JGBs). Despite its huge budget deficit, the Japanese economy can sustain the stability of the bond market. Many Europeans ask why Japan is still stable while Greece and other European countries are in serious trouble.

The differences between Japan and Greece can be found in the demand for government debt, rather than the supply of government debt. More than 90% of the Government of Japan’s debt is held by domestic investors in banks, postal savings, life insurance, and pension funds. The Japanese government issues various kinds of bonds based on demand by differing sectors, and the government bond market has

been quite stable in Japan. Japanese investors continue to hold government bonds, since Basel capital requirements set the risk of government bonds at zero. On the other hand, more than 70% of investors in Greece’s bond market are foreign and they have been quick to move out of the market at times of risk.

Figure 2 depicts the supply of government bonds and the demand for government debt in Japan and Greece. The vertical line shows the supply of government bonds in the primary market, since no matter what the rate of interest, the government has to finance its budget deficits. The demand for government bonds increases when the interest rate rises. Thus the demand curve for government bonds is upward sloping in the figure.

Figure 2: Government Bond Markets of Japan and Greece



Source: Yoshino and Taghizadeh-Hesary (2014a).

Both Japan and Greece have increased their sales of government bonds, meaning that the supply curve of government bonds has shifted to the right in the primary market. The demand for Japanese government bonds by banks, insurance companies, and pension funds has been increasing as the sluggish economy has reduced demand for corporate loans (Figure 2). Monetary easing has increased bank deposits and these funds have often been invested in government bonds. Japanese interest rates, therefore, remain low.

The behavior of holders of Japanese and Greek debt is distinctive (Table 1). Overseas investors, who hold 70% of government bonds in Greece, are quick to sell them if they feel that risk is increasing. As demand for Greek bonds has diminished, the demand curve of the bonds has shifted to the left (see Figure 2, right-hand graph), which has progressively raised the interest rate on Greek bonds. The Greek interest rate increased to more than 20%, while the Japanese interest rate has remained at about 1% or less (as shown in the downward sloping dashed line of Figure 3). Since only 5% of the total bonds issued by the Japanese government are held by overseas investors, there is much less likelihood of capital flight, since domestic holders tend to retain their investments (Yoshino and Mizoguchi 2013b).

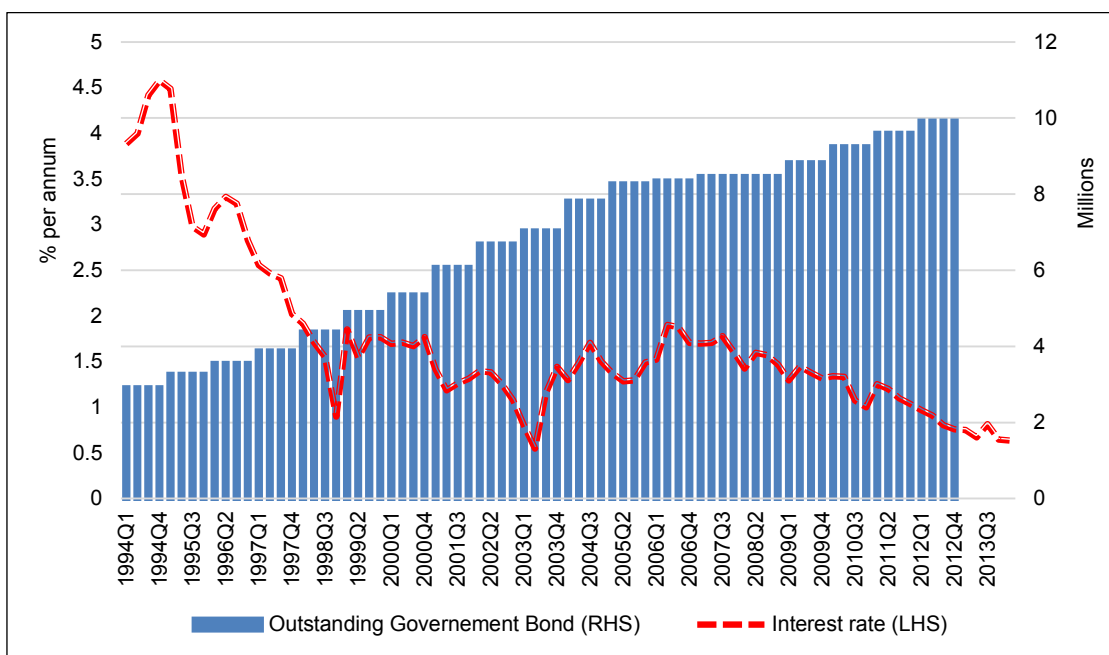
Table 1: Holders of Japanese and Greek Government Bonds, 2011

Holders of Japanese Government Bonds	% of Total	Holders of Greek Government Bonds	% of Total
Bank and postal savings	45	Overseas investors	33
Life and non-life insurance	20	Domestic investors	21
Public pension funds	10	European Central Bank	18
Private pension funds	4	Bilateral loans	14
Bank of Japan	8	Social pension funds	6
Overseas investors	5	International Monetary Fund	5
Households	5	Greek domestic funds	3
Others	3		

Note: In Greece, 70% of debt is held by overseas investors, compared with 5% for Japan.

Source: Yoshino and Taghizadeh-Hesary (2014b).

Figure 3: Interest Rate and Government Bonds Outstanding



Note: The right-hand scale shows outstanding government bonds and other government borrowings. The annual data was converted to annual data and exponentially smoothed. The interest rate is the 10 year-yield of the Japanese government bonds.

Source: NIKKEI NEEDS database.

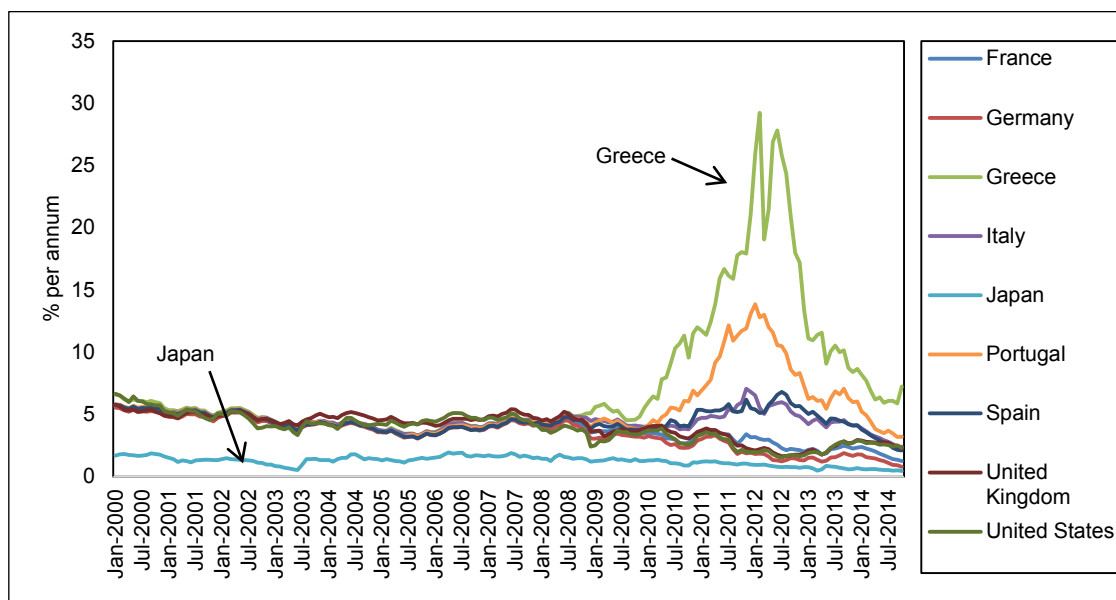
Japan has achieved the highest life expectancy in the world and the Japanese economy is facing an aging population. Because of the aging population, social welfare costs have started to increase and currently one-third of government spending is allocated to social welfare, while the government budget deficit is rising every year. In the general account budget for 2015, social security accounts for 32.7% of the total budget. This is the major reason for the increase in the amount of outstanding government bonds as shown in Figure 3. The second reason for this continuous budget deficient is the high payments from the central government to local governments. Around 16% of total government spending is allocated for transfer from the central government to local governments and is the second-largest government expense after

social security. Many local governments rely on central government transfers without making efforts themselves to revitalize their regional economies (Yoshino and Taghizadeh-Hesary, forthcoming 2016).

Figure 4 shows the government bond interest rates of selected OECD countries. The Greek government bond interest rate increased suddenly when the country’s budget deficit was in a serious condition and could not be redeemed by tax payers’ money. Foreign investors asked for a risk premium for Greek government bonds and foreign investors started to sell Greek bonds, which increased the interest rate even further. In contrast, the bottom line in the figure shows the Japanese government bond interest rate, which is the lowest among the selected OECD countries for the reasons explained in Figure 2.

Japan’s demand for government bonds is increasing and the demand curve for government bonds is shifting to the right, since banks, insurance companies, and pension funds, etc. are looking to encourage investment. Banks have continued to receive deposits and are looking for investment in government bonds. Insurance and public pension funds in Japan are inclined to invest in government bonds, as they are regarded as safe assets. Therefore, the demand for government bonds has been increasing, so the demand curve for government bonds has been increasing and has kept the Japanese interest rate low.

Figure 4: Interest Rates in Selected OECD countries



OECD = Organisation for Economic Co-operation and Development.

Note: The rate is the 10-year government bond interest rate. Generally, the yield is calculated at the pre-tax level before deductions for brokerage costs and commissions, and is derived from the relationship between the present market value of the bond and the value at maturity, taking into account interest payments paid through to maturity.

Monthly figures shown are calculated as the average of weighted or un-weighted arithmetic rates relating to all days or specified days in the month or to a day at or near the month’s end. For short- and long-term interest rates, annual and quarterly data are the averages of the monthly figures, while for “overnight” rates, annual and quarterly data usually refer to the figure for the final month of the period.

Source: Monthly Monetary and Financial Statistics (MEI), OECD statistics, released 5 May 2015.

Regarding the government bond markets, the Domar condition and Bohn’s condition are often used in the literature to check whether the economy is in a dangerous zone or not. Domar suggests that an economy should make its interest rate lower than the

growth rate of the economy. Bohn proposes that a primary balance has to be maintained so that the debt-to-GDP ratio does not diverge from its original level.

The purpose of this paper is twofold. The first point we will argue is that the Domar condition is obtained only from the government budget constraint (namely the supply of government bonds) and does not take into account the demand for government bonds. A simple comparison of the interest rate and the growth rate of the economy is not adequate to check the stability of the government budget deficit as both the interest rate and the growth rate of the economy are determined endogenously in the model.

The second point is that Bohn's condition satisfies the stability of the government budget in the long run by imposing constraints for the primary balance. However, it does not achieve economic stability. Even if Bohn's condition is satisfied, the recovery of the economy may not be achieved. This paper will propose a new condition that can satisfy both the stability of the government budget and the recovery of the economy.

The paper is organized as follows. Section 2 provides the related literature. Section 3 shows firstly a revision of the Domar condition by including both the supply and demand for government bonds in the model. Secondly, it shows that Bohn's condition addresses only the stability of the government budget constraint and that the recovery of the economy might not be achieved by simply applying Bohn's rule. The new conditions for the stability of the government budget deficit and the recovery of the economy are provided in this section. Section 4 provides the mathematical model for the new fiscal policy rule, which satisfies both the stability of the government budget and the recovery of the economy. Section 5 provides the empirical survey of the proposed fiscal policy rule for Japan. Section 6 contains the concluding remarks.

2. RELATED LITERATURE

There is substantial research concerning the fiscal sustainability conditions of the government budget constraint. The sustainability of public debt can be examined from the government budget constraint in the fiscal policy literature. Bohn (1998) proposed a different fiscal sustainability test to estimate the transversally condition. He found that an increase in the ratio of government deficit to GDP increased the ratio of the primary surplus to GDP from 1916 to 1995 in the United States (US). He concluded that US fiscal policy sustained an intertemporal budget constraint. Bohn (2005) also examined the sustainability of US fiscal policy by using data from the US fiscal records from 1792—2003 and critically reviewed the sustainability conditions and their testable implications, applying them to US data to emphasize the ramifications of economic growth. A "growth dividend" has historically covered the entire interest bill on US debt. Unit root tests on real series, unscaled by GDP, are distorted by the series' severe heteroskedasticity. The most credible evidence in favor of sustainability is the robust positive response of primary surpluses to fluctuations in the debt-to-GDP ratio.

For Japanese cases, there are also substantial empirical studies on this issue. A study by Yoshino and Mizoguchi (2010) investigates the role of the Liberal Democratic Party on the field of public expenditure. The study shows that spending initially fueled Japan's rapid postwar growth and kept the LDP in power for most of the last half-century. However, after the economic bubble burst in 1990, the country fell into a long economic malaise, called the "lost decade." Considering the current JGB circumstances in Japan, we introduce the stability condition for the government bond market by taking into account of government supply and demand for government bonds by financial institutions. McNelis and Yoshino (2012) applied Bayesian estimation to an open-economy dynamic stochastic general equilibrium (DSGE) model

of Japan. They found that the emergence of even a small risk premium on government debt will trigger significant instability in the real and nominal variables. Yoshino and Mizoguchi (2013a) investigated the features of the flow of funds in Japan across time. They demonstrated that an increased volume of corporate savings was deposited as liquid savings and used to purchase Japanese government bonds through financial institutions via the flow of funds. They also showed that those who demand JGBs play an important role in the stability of the market. Recently, Yoshino, and Vollmer (2014) compared Greece with Japan to explain why Japan has not yet suffered from a debt crisis even though its gross government debt-to-GDP ratio is much larger than Greece's. In Japan, a large share of government debt is being held domestically, there are substantial central bank holdings of government debt, and autonomous monetary policy can be used to ease financial crisis. Based on their model analysis, they show why Japanese domestic investors hold such huge amounts of JGBs. Ito and Hoshi (2014) used a simulation method to see whether Japan's budget deficits are sustainable and concluded that Japan's fiscal situation is in a dangerous zone.

Previous analysis, such as that by Bohn (1998, 2005) only used the government budget constraint for the stability of the government bond market. In our model, the fiscal sustainability of government bonds in Japan can be explained by the demand for government bonds rather than the supply. We consider this to be representative of reality. Our paper presents a new stability condition for the bond market. We also present some rules for fiscal stabilization and explain the fiscal rules corresponding to Taylor's rule for monetary policy.

3. THE REVISED DOMAR CONDITION AND BOHN'S CONDITION COMBINED WITH THE BOND MARKET

The Domar condition and Bohn's condition are often used to determine whether budget deficits are sustainable or not.

The Domar condition is obtained from the government budget constraint as follows.

$$G_t + r_t B_{t-1} = \Delta B_t + T_t \quad \text{Government Budget Constraint (1)}$$

Equation (1) states that government spending (G_t) + interest payments ($r_t B_{t-1}$) = new issue of government bonds (ΔB_t) + tax revenue (T_t).

Dividing Equation (1) by GDP (Y_t) and rewriting Equation (1), we get

$$b_t - b_{t-1} = \frac{(r_t - \eta_t)}{1 + \eta_t} b_{t-1} + g_t - t_t \quad \text{Domar Condition (2)}$$

where $b_t = B_t/Y_t$, $\eta_t = \Delta Y_t/Y_t$, $g_t = G_t/Y_t$, and $t_t = T_t/Y_t$

Equation (1) denotes the government budget constraint, which describes the supply of government bonds. Dividing Equation (1) by Y_t and with a few transformations, the Domar condition in Equation (2) is obtained. If the interest rate is higher than the growth rate of the economy, the budget deficit will increase rapidly. On the other hand, if the interest rate is lower than the growth rate of the economy the budget deficit will converge in a stable manner. However, the Domar condition focuses only on the

supply of government bonds and does not take into account the demand for government bonds.

4. MATHEMATICAL MODEL

This paper describes the equations of both the government bond supply and the government bond demand based on the model set out by Yoshino and Mizoguchi (2010, 2013b). Our model is summarized as follows:

$$G_t + r_t^B B_{t-1} = \Delta B_t^S + T_t + \Delta M_t$$

Government budget constraint = Supply of government bonds (3)

$$\Delta B_t^D = b_0 + b_1 r_t^B$$

Demand for government bonds (4)

From Equations (3) and (4), we obtain the equilibrium interest rate of government bonds:

$$r_t^{B*} = \frac{G_t - T_t - b_0 - \Delta M_t}{b_1 - B_{t-1}} \quad (5)$$

A simple macro model that includes the demand side of the government bond can be constructed as follows.

Equation (3) is the disposable income, showing wage income, transfer payments from the government, and interest received from government bonds, minus tax payments. The disposable income is distributed into consumption and savings. Savings are allocated for the purchase of government bonds, for money demand, and to increase domestic deposits.

Disposable income is defined as income (Y_t) plus g , the interest received from government bonds by households ($r_t^B B_{t-1}$), minus the tax payment (T_t) as follows. The disposable income is divided into consumption (C_t) and savings (S_t)

$$YD_t = Y_t - T_t + r_t^B B_{t-1} = C_t + S_t$$

where $S_t = \Delta B_t + \Delta M_t + \Delta W_t^D$ (6)

Savings (S_t) = Government bonds (ΔB_t) + money demand (ΔM_t) + domestic deposits (ΔW_t^D).

$$I_t = i_0 - i_1 r_t \quad \text{Investment Function} \quad (7)$$

$$C_t = c_0 + c_1 YD_t \quad \text{Consumption Equation}^1 \quad (8)$$

$$\Delta W_t^D = d_0 + d_1 YD_t + d_2 r_t \quad \text{Deposit equation} \quad (9)$$

Consumption depends on disposable income, for simplicity. The deposit market is expressed as the supply of deposits and the demand for deposits in Equation (9). The demand for deposits is explained by disposable income and the interest rate of government bonds. If the interest rate for government bonds increases, households will

¹ We assume that the consumption function is a Keynesian consumption function, non-Ricardian type.

want to buy more government bonds and reduce the amount of deposits. All deposits are used for bank loans to satisfy investment.

From Equations (6)-(9), we have the IS-balance equation.

$$(1 - c_1)Y_t - c_1 r_t^B B_{t-1} + i_1 r_t = c_0 + i_0 + G_t - c_1 T_t \quad \text{IS-Balance} \quad (10)$$

We assume that investment in the private sector will be financed by deposits in the banking sector. For convenience, with regards to the banking sector's behavior, it is simply assumed that savings are used for the purpose of investment.

$$\Delta W_t^D = I_t \quad \text{Saving-Investment Equilibrium} \quad (11)$$

By using Equations (10) and (11), we obtain income and the interest rate in the short-run equilibrium as follows:

$$Y_t^* = \frac{1}{\Delta} \{ (d_1 + i_1)c_0 + d_1 i_0 + i_1 d_0 + (d_1 + i_1 + d_1 i_1)G_t - ((d_1 + i_1)c_1 + d_1 i_1)T_t + (d_1 + i_1)c_1 + d_1 i_1 \} r_t^{B*} B_{t-1} \quad (12)$$

$$r_t^* = \frac{1}{\Delta} \{ (1 - c_1)(i_0 - d_0) - d_1(c_0 + i_0) - d_1 G_t + d_1 T_t - d_1 r_t^{B*} B_{t-1} \} \quad (13)$$

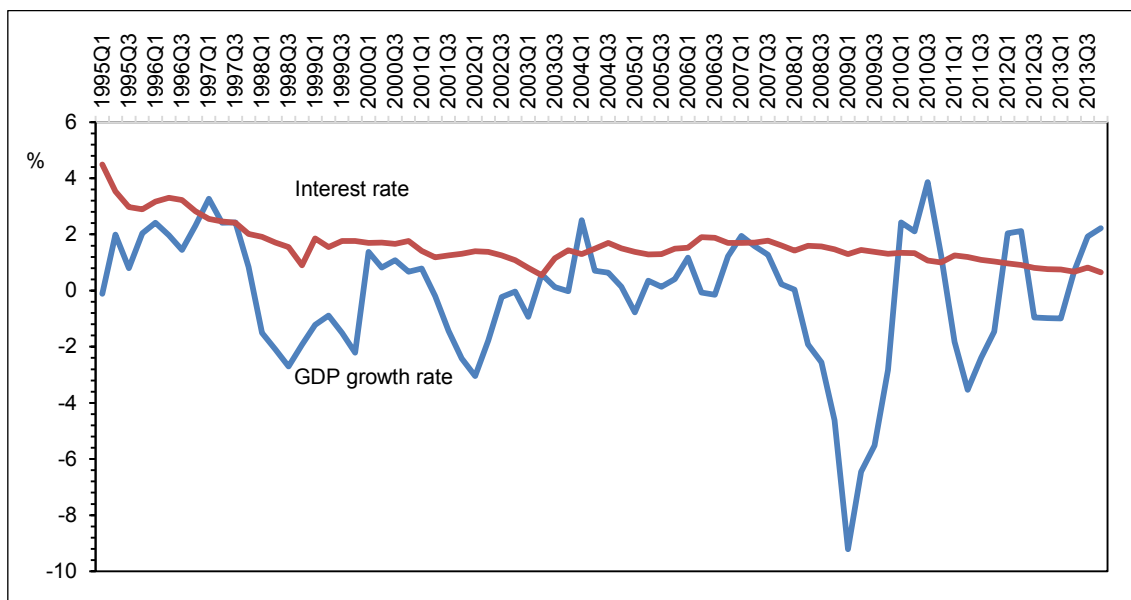
where $\Delta = (1 - c_1)(d_2 + i_1) - d_1 i_1$ and $r_t^{B*} = \frac{G_t - T_t - b_0 - \Delta M_t}{b_1 - B_{t-1}}$.

In the next section, we use the equilibrium interest rate and income to derive the optimal fiscal rule.

4.1 Revised Domar Condition Combined with the Bond Market

Figure 5 shows the trend of the long-term interest rate (10-year Japanese government bond yield) and nominal GDP growth rate of Japan. As the figure shows, particularly during 2003–2009, the long-term interest rate and nominal GDP growth rate are approximately co-moving. The figure shows that the rate of interest exceeds the growth rate of the economy. It suggests that the Japanese budget is on an unstable path, based on the Domar condition. Applying the Domar condition and the case studies of Polito and Wickens (2007), the data shows the instability of bond financing in Japan. Compared with the stability condition in Bohn (1998) and other studies, our model considers the structure of the bond market. Since both the interest rate and bond supply and demand are endogenous in our model, we can investigate the stability condition based on the each economic variable in the economy.

Figure 5: The Real GDP Growth Rate and the Long-term Interest Rate in Japan



GDP = gross domestic product.

Note: The GDP growth rate for each quarter is compared to the previous year and seasonally adjusted. The interest rate is the 10-year Japanese government bond yield.

Source: Quarterly estimates of GDP, Economic and Social Research Institute (ESRI), Cabinet Office of Japan; Nikkei NEEDS.

5. FISCAL POLICY RULE AND TAX RULE TO ACHIEVE SUSTAINABILITY OF THE BUDGET

The fiscal policy rule can be obtained as follows.

The objective function of the government is set as:

$$L(B_t, Y_t, G_t, T_t, \Delta B_t) = \frac{1}{2}w_1(B_t - B_t^*)^2 + \frac{1}{2}w_2(Y_t - Y_t^f)^2 + \frac{1}{2}w_3(G_t - G_{t-1})^2 + \frac{1}{2}w_4(T_t - T_{t-1})^2 + \frac{1}{2}w_5(\Delta B_t - \Delta B_t^*)^2 \quad (14)$$

The government aims to stabilize government debt (B_t) as close as possible to its desired level, with GDP (Y_t) close to the full employment level of GDP (Y_t^f), and with a smooth change of government spending (G_t), smooth change of taxation (T_t), and smooth change of the flow of bonds (ΔB_t). Here w_i ($i = 1, \dots, 5$) are the policy weights the government can set.

We minimize the loss from the government's objective function by means of government spending (G_t) and the smooth change of taxation (T_t).

$$\begin{aligned} \min_{G_t, T_t} L(B_t, Y_t, G_t, T_t, \Delta B_t) \\ = \frac{1}{2}w_1(B_t - B_t^*)^2 + \frac{1}{2}w_2(Y_t - Y_t^f)^2 + \frac{1}{2}w_3(G_t - G_{t-1})^2 + \frac{1}{2}w_4(T_t - T_{t-1})^2 \\ + \frac{1}{2}w_5(\Delta B_t - \Delta B_t^*)^2 \end{aligned}$$

The first-order conditions are:

$$\frac{\partial L}{\partial G_t} = w_1(B_t - B_t^*) \left(\frac{\partial B_t}{\partial G_t} \right) + w_2 \frac{\partial Y_t}{\partial G_t} (Y_t - Y_t^f) + w_3(G_t - G_{t-1}) + w_5(\Delta B_t - \Delta B_t^*) \left(\frac{\partial \Delta B_t}{\partial G_t} \right) = 0^2 \quad (15)$$

$$\frac{\partial L}{\partial T_t} = w_1(B_t - B_t^*) \left(\frac{\partial B_t}{\partial T_t} \right) + w_2 \frac{\partial Y_t}{\partial T_t} (Y_t - Y_t^f) + w_4(T_t - T_{t-1}) + w_5(\Delta B_t - \Delta B_t^*) \left(\frac{\partial \Delta B_t}{\partial T_t} \right) = 0^3 \quad (16)$$

From Equation (15), we obtain our government spending rule.

$$G_t - G_{t-1} = \alpha_1(B_t - B_t^*) + \alpha_2(\Delta B_t - \Delta B_t^*) + \alpha_3(Y_t - Y_t^f) \quad \text{Government Spending Rule} \quad (17)$$

$$\text{where } \alpha_1 = \frac{w_1}{w_3} \left(\frac{B_{t-1}}{b_1 - B_{t-1}} + 1 \right), \quad \alpha_2 = \frac{w_5}{w_3} \left(\frac{B_{t-1}}{b_1 - B_{t-1}} + 1 \right), \quad \alpha_3 = -\frac{w_2}{w_3} \left(\frac{(d_1 + i_1) + d_1 i_1}{\Delta} \right)$$

$$T_t - T_{t-1} = \beta_1(B_t - B_t^*) + \beta_2(\Delta B_t - \Delta B_t^*) + \beta_3(Y_t - Y_t^f) \quad \text{Taxation Rule} \quad (18)$$

$$\text{where } \beta_1 = -\frac{w_1}{w_4} \left(\frac{B_{t-1}}{b_1 - B_{t-1}} + 1 \right), \quad \beta_2 = -\frac{w_5}{w_4} \left(\frac{B_{t-1}}{b_1 - B_{t-1}} + 1 \right), \quad \beta_3 = \frac{w_2}{w_4} \left(\frac{(d_1 + i_1)c_1 + d_1 i_1}{\Delta} \right).$$

From these two first-order conditions, we can find the relationship between $G_t, T_t, (B_t - B_t^*), (\Delta B_t - \Delta B_t^*)$ and the primary balance.

$$PB_t - PB_{t-1} = (\alpha_1 - \beta_1)(B_t - B_t^*) + (\alpha_2 - \beta_2)(\Delta B_t - \Delta B_t^*) + (\alpha_3 - \beta_3)(Y_t - Y_t^f) \quad (19)$$

Equation (19) implies that the government should not only check the desirable changes between GDP and the primary balance, but also set up the rule for the changes in both government expenditure and taxation. It should also not only check the difference between the GDP/debt ratio and desirable GDP/debt ratio (Bohn's condition), but also implement the policy by checking the changes in government expenditure and taxation in the previous year and the trend in the business cycle. From Equations (17) and (18), when the government simultaneously implements structural reforms and policies to reduce government spending, such as social security for the aging population, these policies will smooth the GDP gap and the level of government expenditure. Therefore these will reduce the likelihood of default. Our proposed fiscal policy rules, an expansion of Bohn's condition, imply that governments should implement policies by checking (a) the strict control of issuing government bonds and (b) the business cycle for fiscal sustainability.

6. EMPIRICAL SURVEY

We used quarterly data from Q1 1994 to Q4 2014, a period which includes the post-bubble era of the Japanese economy, the 1997–1998 Asian financial crisis, the 2008–2009 global financial crisis, and the 2011 Great East Japan earthquake and tsunami.

The government expenditure used in our empirical survey is the total public demand and tax is the total government tax revenue, both seasonally adjusted. Money demand

² $\frac{\partial B_t}{\partial G_t} = \frac{B_{t-1}}{b_1 - B_{t-1}} + 1, \quad \frac{\partial Y_t}{\partial G_t} = \frac{(d_1 + i_1) + d_1 i_1}{\Delta}, \quad \frac{\partial \Delta B_t}{\partial G_t} = \frac{B_{t-1}}{b_1 - B_{t-1}} + 1$
³ $\frac{\partial B_t}{\partial T_t} = -\left(\frac{B_{t-1}}{b_1 - B_{t-1}} + 1 \right), \quad \frac{\partial Y_t}{\partial T_t} = -\frac{(d_1 + i_1)c_1 + d_1 i_1}{\Delta}, \quad \frac{\partial \Delta B_t}{\partial T_t} = -\left(\frac{B_{t-1}}{b_1 - B_{t-1}} + 1 \right)$

is M2, the average amount of outstanding money stock based on the year-on-year change. For the outstanding bonds we used the total outstanding JGBs and other borrowings of the Japanese government. Consumption is private consumption, income is GDP, and investment is private investment, all seasonally adjusted and in real terms, deflated by the GDP deflator (2009=100). The newly issued bonds are the new issues of public bonds and new issues of government bonds. The sources of the data are time series data from the Bank of Japan (BOJ), International Financial Statistics (IFS) of the International Monetary Fund (IMF), Economic and Social Research Institute (ESRI), the Japanese Cabinet Office, Nikkei NEEDS, and OECD Economic Outlook.

To evaluate the stationarity of the series, we used an augmented Dickey–Fuller test. The results suggest that variables for outstanding government bonds, investment, interest rate, and private deposits are non-stationary in level. However, when we applied the unit root test to the first difference of the variables, we were able to reject the null hypothesis of unit roots for each of the variables. These results suggest that the government bond, investment, interest rate, and private deposit variables each contain a unit root. Once the unit root test was performed and it was discovered that the variables were non-stationary in level and stationary in the first differences, they were integrated of order 1. Hence, variables will appear in the econometric model in first differences. We used ordinary least squares (OLS) in order to run the regressions for each equations. We used the Akaike Information Criterion to select the lag orders.

Prior to running the regressions we plotted Figures 6, 7, and 8 in order to identify any outlier points.

Figure 6: Changes in Income versus Saving

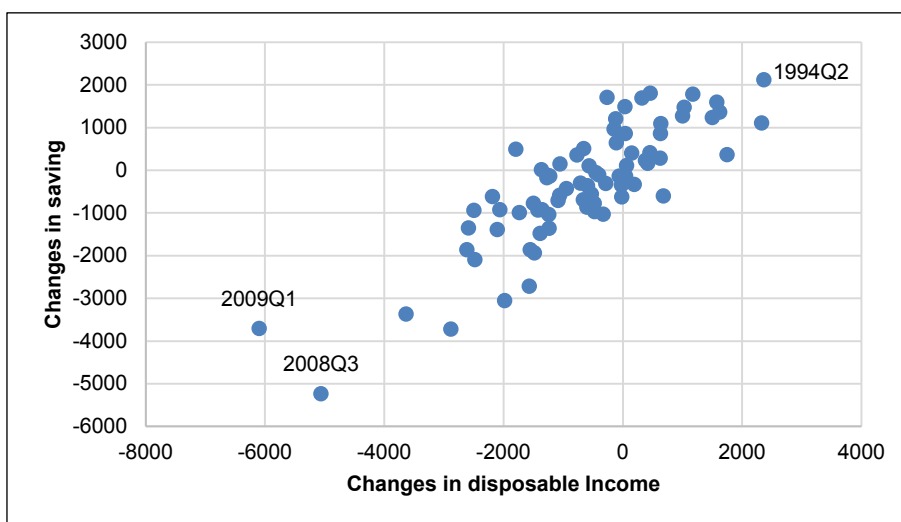


Figure 7: Changes in Income versus Private consumption

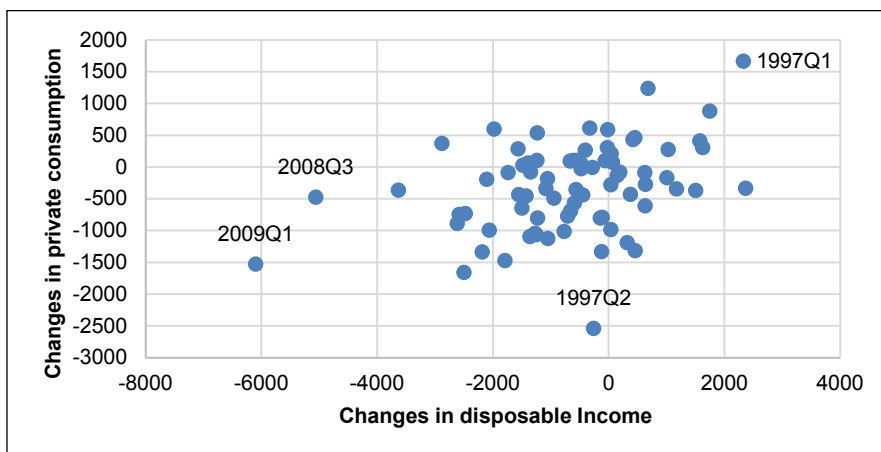
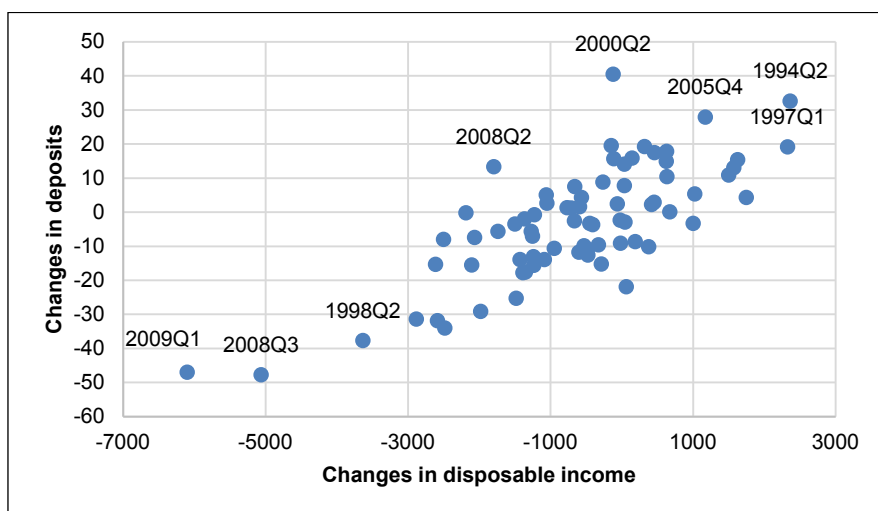


Figure 8: Changes in Income versus Deposits



Note: Deposits = saving – demand for government bonds

Data points for 2000Q1 and 2001Q1 are not shown as they are outside the figure.

Source: Nikkei NEEDS.

For the outlier points, which were mainly found during the crisis periods, we defined a dummy variable for each of the related equations.

Below are the results of the regressions:

Eq. 4: Demand for government bonds: $\Delta(B_t) = 8444390 + 1336455(r_t)$

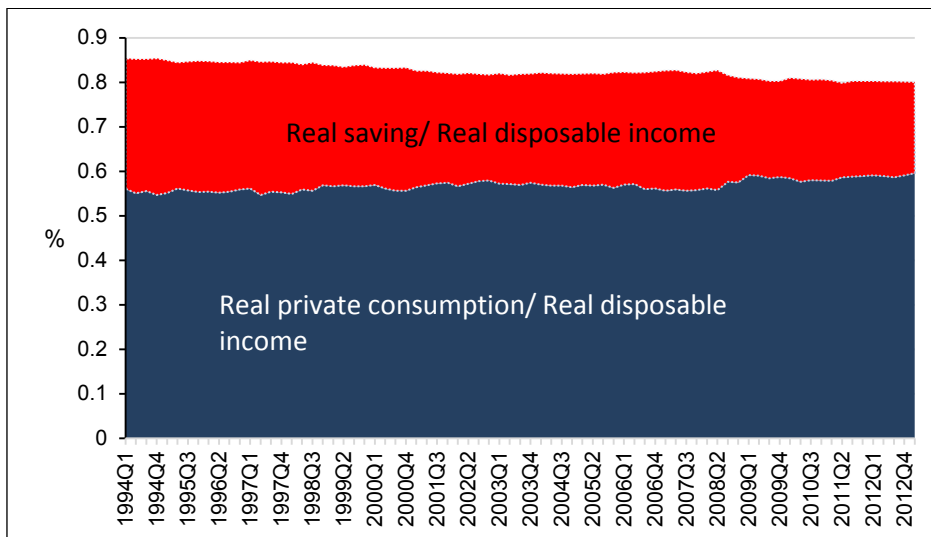
Eq. 7: Investment function: $\Delta(I_t) = 85153 - 2125[\Delta(r_t)]$

Eq. 8: Consumption equation: $C_t = 9445 + 0.53(YD_t)$

Eq. 9: Deposit equation: $\Delta(W_t^D) = -10828237 + 0.22(YD_t) - 675616(r_t)$

Equation 8 shows the marginal propensity to consume to be 0.53, and Figure 9 empirically shows this fact. Figure 9 exhibits real private consumption and real households' saving as a percentage of real disposable income during Q1 1994–Q1 2013. The share of savings in Japanese households' income declined during the period because after more than 2 decades amid a stagnant economy, Japanese households became less rich than they were in the 1970s and 1980s.

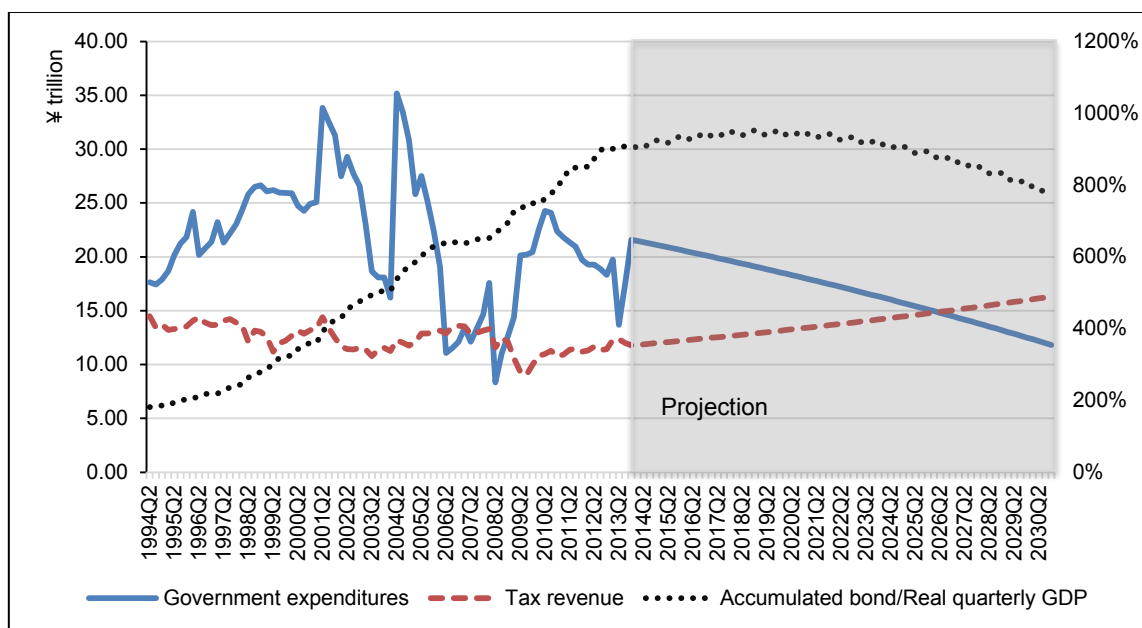
Figure 9: Japanese Real Private Consumption and Real Household Savings as a Percentage of Real Disposable Income, Q1 1994–Q1 2013



Source: Nikkei NEEDS

Consequently we calculate the government spending rule (Equation 17) and taxation rule (Equation 18) based on our model by assuming that the five policy weights in our government objective function are equal to 0.2, and that during 2014–2030 the Japanese real GDP grows annually by 2% from the previous year. Figure 10 shows the past actual government spending and tax revenue of the Japanese government (Q2 1994–Q4 2013) and the projected government spending and tax revenue (Q1 2014–Q4 2030) based on our model.

Figure 10: Government Expenditure and Tax Revenue



Note: The gray shaded area indicates the projected values. The left-hand axis indicates government expenditures (primary expenses) and tax revenue, and the right-hand axis indicates the accumulated bonds/real quarterly GDP.

Source: Raw data are from Nikkei NEEDS, projection values are compiled by the authors.

As illustrated in Figure 10, in order to act as per the optimal fiscal policy rule provided in this paper and in order to reduce the amount of national debt from its present high

level, Japanese government expenditure needs to be reduced drastically and the government tax revenue needs to shift upward. This means that both sides of the budget need to be adjusted simultaneously (expenditure and revenue) in order to achieve fiscal sustainability. Further, as is apparent from this figure, the decrease in expenditure needs to be more than the increase on the revenue side. As per our calculations for 2014–2030, the Japanese government needs to cut expenditure by 45% and raise tax revenue by 38%, for the purpose of fiscal sustainability. For this, accumulated government bonds/real GDP needs to be reduced from 228% in Q4 2013 to 196% in Q4 2030.

7. CONCLUSION

This paper addresses the issue that the conventional Domar condition for the stability of the budget is obtained only from the supply side for government bonds, namely the government budget condition. It is important to also take into account the demand side of government bonds. Japan and Greece have both accumulated a large amount of government debt, but Greece went bankrupt whereas Japan's debt has been sustainable. We have shown that the demand structure of government bonds in Japan is dominated by domestic investors. On the other hand, in Greece, demand is dominated by overseas investors. This high ratio of overseas investors was the cause of the increase in the interest rate of government bonds in Greece.

As Bohn's condition does not satisfy economic recovery and only gives the condition to retain the budget balance, the optimal government spending rule and tax revenue rule have to be obtained. The optimal fiscal policy rule has to examine how government debt diverges from the desired level, how the flow of the government budget deficit diverges from the desired level, and the GDP gap. The new fiscal policy rule obtained in this paper satisfies the conditions for both the stability of the budget and the recovery of the economy at the same time.

Consequently, the empirical findings show that in order to achieve fiscal sustainability based on the optimal fiscal policy rule proposed in this paper, both sides of the Japanese government budget (expenditure and revenue) need to be adjusted simultaneously. The results show that the decrease in government expenditure has to be more than the increase in tax revenue.

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