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Fiscal policy conditions for government budget stability and economic recovery: Comparative analysis of Japan and Greece

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ADB Working Paper Series

**FISCAL POLICY CONDITIONS FOR GOVERNMENT
BUDGET STABILITY AND ECONOMIC RECOVERY:
COMPARATIVE ANALYSIS OF JAPAN AND GREECE**

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Abstract

In the literature regarding fiscal sustainability, the Domar condition and Bohn's condition are often used to check whether a government's debt situation is in a dangerous zone. This paper first shows 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. Second, this paper reveals that Bohn's condition does not satisfy the condition of economic stability: even if this is satisfied, economic recovery 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's empirical findings from Japan demonstrate that in order to achieve fiscal sustainability, both sides of the Japanese government budget (expenditure and revenue) must be simultaneously adjusted while the decline in government expenditure has to exceed the increase in tax revenue. In addition, the paper provides a comparative analysis of Japan and Greece as evidence of the aforementioned condition, and proves that although Japan's debt-to-GDP ratio is higher than that of Greece, its bond market remains stable. This is because it comes from the demand side of the market and investors have greater confidence in this economy due to its lower credit risk rooted in the country's macroeconomic strength and more auspicious economic future.

Keywords: Japanese bond market, Greece economy, fiscal sustainability, fiscal policy condition, government debt management

JEL Classification: E42, E63

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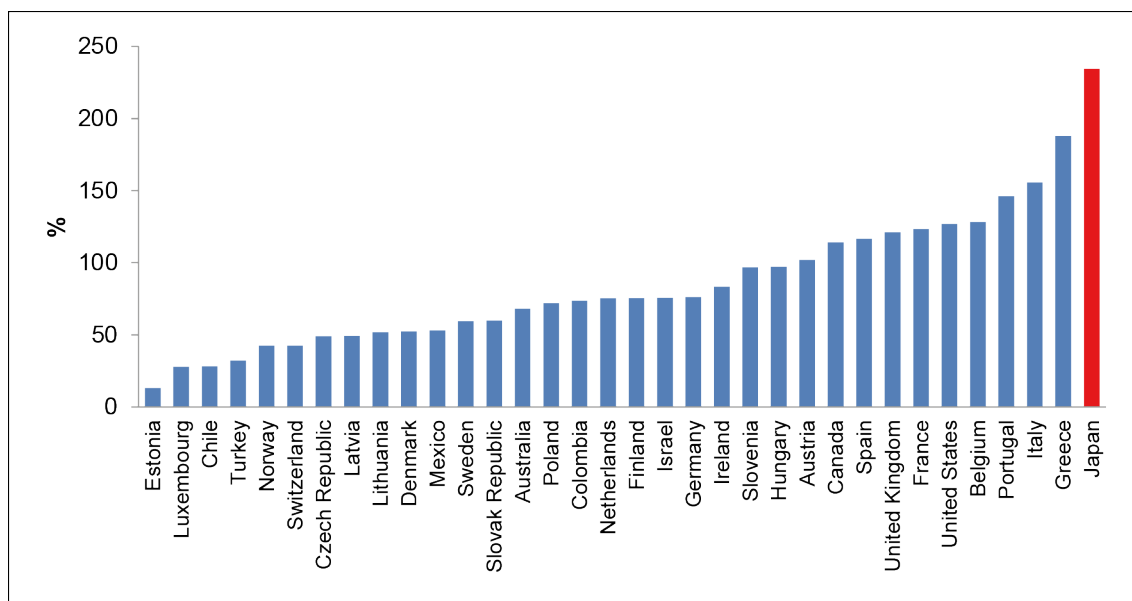
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1. INTRODUCTION

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 234.5% (Figure 1). Interestingly, Japan’s debt remains sustainable, whereas the southern European countries Greece and Cyprus went bankrupt due to their high government deficits, even though their debt-to-GDP ratios were lower.

Figure 1 illustrates general government gross financial liabilities as a percentage of GDP for selected OECD countries. It can be seen that the ratio for Japan is the highest, at 234.5% in 2016. Following Japan, Greece and Italy have the second and third highest levels at 187.9% and 155.6%, respectively. Estonia has the lowest ratio among OECD countries, at 13.1%.

Figure 1: Gross Debt/Gross Domestic Product in Selected OECD Countries, 2016



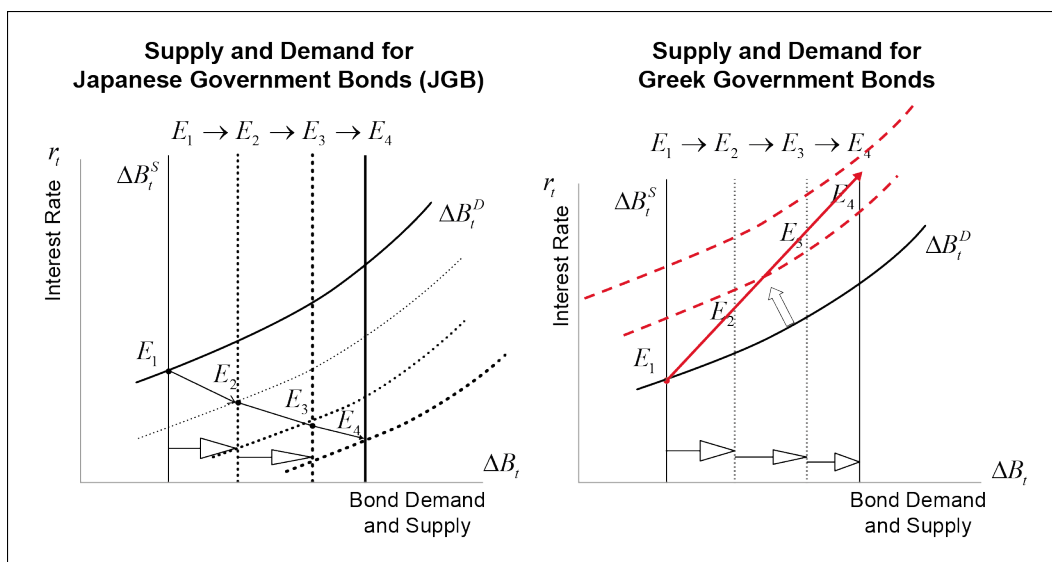
Note: General government gross financial liabilities as a percentage of GDP.
 Source: OECD (2018a), General government debt (indicator). doi: 10.1787/a0528cc2-en (Accessed on 26 June 2018).

Japan’s accumulated government debt now amounts to more than 235% of its GDP. In spite of its large budget deficit, the Japanese economy has been able to sustain its bond market’s stability. Many Europeans ask why Japan remains 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 Japanese government’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 among differing sectors, and the government bond market has remained quite stable. 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 upwardly 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.

Holders of Japanese and Greek debt demonstrate distinctive behavior (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 29% in February 2012, whereas Japan’s interest rate has remained at about 1% and most recently near to zero¹ (as shown in the downward slopping dashed line of Figure 3). Given that only 5% of the total bonds issued by the Japanese government are held by overseas investors, the likelihood of capital flight is much lower since domestic holders tend to retain their investments. Greece’s bond

¹ Since 29 January 2016, the Bank of Japan has implemented a negative interest rate policy. The long-term interest rate of the Japanese government bond (JGB) has also been affected and the JGB yield curve started to fall and flatten. This means that it is not rational to hold JGB until maturity. Hence, investors (and especially overseas investors) are trading the bonds rather than keeping them until maturity. The nominal interest rate has dropped, but the volatility of the bond market has increased owing to the higher trading of bonds. (For more information see: Yoshino, Taghizadeh and Miyamoto 2017 and Yoshino Taghizadeh-Hesary and Tawk 2017.)

demand is strongly affected by overseas' investors where they compare Greece's interest rate and overseas interest rate. An empirical estimation in Section 4 shows the significant impact of overseas interest rate on demand for Greece bonds.

Table 1: Holders of Japanese and Greek Government Bonds

Holders of Japanese Government Bonds		Holders of Greek Government Bonds	
	% of Total		% 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).

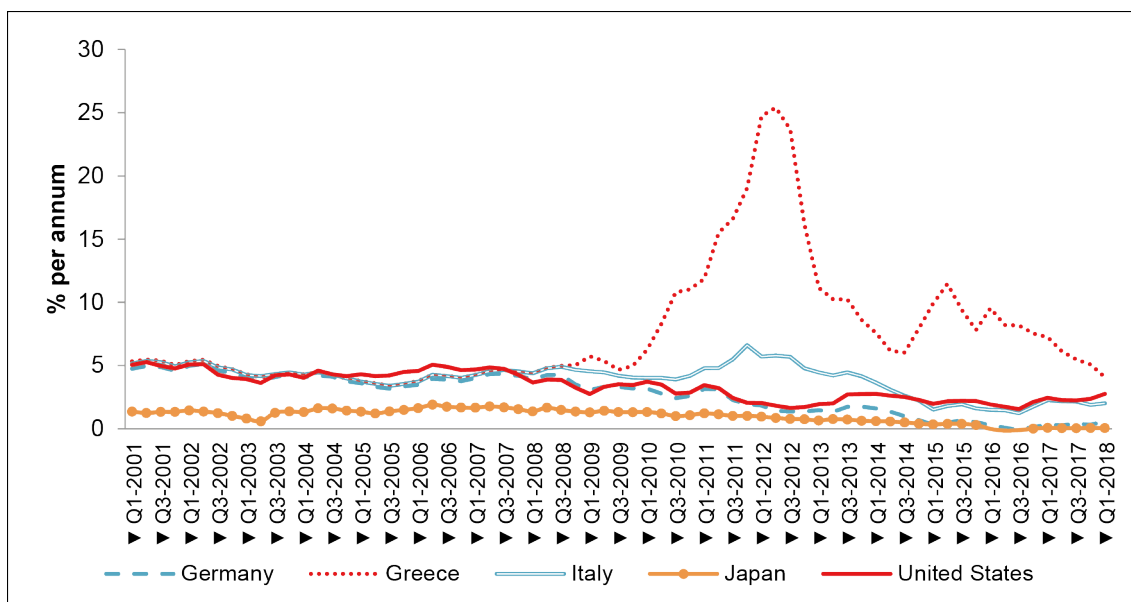
Japan has achieved the highest life expectancy in the world and the Japanese economy is facing an aging population. Owing to its aging population, social welfare costs have started to increase and currently one-third of government spending is allocated to social welfare, while the government budget deficit is rising every year. In the general account budget for 2017, social security accounted for 33.3% of the total budget (MOF 2017). This represents the primary reason for the increase in the amount of outstanding government bonds. The second reason for this continuous budget deficit is the high rate of 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 constitutes 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 2016).

Figure 3 illustrates the government bond interest rates of selected OECD countries. The Greek government bond interest rate suddenly increased when the country's budget deficit came into serious difficulties 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 depicts 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, pension funds and so forth 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.

The experiences of Japan and Greece show that the higher interest rate might not be one of the major determinants of demand for the government bond, as saw in 2012–2013, although the interest rate in the Greek bond market was the highest among OECD member countries (Figure 3). However, demand was declining due to higher credit risk associated with the Greek economy, which reduced the demand and further elevated interest rates. Nevertheless, in the case of Japan, although the interest rate is the lowest among OECD member countries, given the strength of its economy and its low credit risk, investors confidently purchase bonds and demand remains, especially among domestic investors.

Figure 3: Long-term Government Bond Interest Rates in Selected OECD Countries (2001Q1–2018Q1)



Source: OECD (2018b), Long-term interest rates (indicator). doi: 10.1787/662d712c-en (Accessed on 26 June 2018).

Regarding the government bond markets, the Domar condition and Bohn’s condition are often used in the literature to determine whether the economy stands in a dangerous zone or not. Domar suggests that an economy should ensure its interest rate is 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 sufficient 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 goal of this paper is to show that the demand for government bonds is one of the major reasons behind the stability of the bond market. The paper will prove this point both theoretically by providing a new fiscal policy condition and empirically using the examples of Japan and Greece.

The paper is organized as follows: Section 2 provides a literature review; Section 3 provides the model; Section 4 sets out the empirical analysis; and Section 5 contains the concluding remarks.

2. LITERATURE REVIEW

Fiscal sustainability became an increasingly critical issue following the global financial crisis. In the past, most of the attention regarding public debt sustainability was focused on developing and emerging market countries. However, the topic is now crucial for developed countries that suffer from rising debt ratios, stagnant economies, unfavorable demographic trends, and liabilities passed from financial sectors.

The International Monetary Fund (IMF) and the World Bank for Low-Income Countries developed a standardized conceptual framework for debt sustainability analyses (DSAs), called the Debt Sustainability Framework for Low-Income Countries separately tracks the evolution of the external liabilities of a country (both public and publicly-guaranteed (PPG) debt, and private non-guaranteed debt) and analyzes the public sector's debts (external and domestic) against key ratios. The DSF then assesses a country's repayment capacity over a long-term horizon by using debt ratios and conducting stress tests. It thus provides a useful tool for LICs to monitor macroeconomic imbalances and to understand structural vulnerability and macro/fiscal risks. Substantial research exists concerning the fiscal sustainability conditions of the government budget constraint.² Tanner (2013) argues that DSAs should constitute more than mere mechanical simulation exercises. Instead, a DSA should be linked to an objective regarding the distribution of fiscal burdens and distortions over time (in the tradition of Barro's 1979 tax smoothing objective). The paper discusses objective functions that yield simple and transparent fiscal policy rules. As in IMF (2011), DSAs could be improved through greater attention to: **I. Realism of baseline assumptions:** Close scrutiny of assumptions underlying the baseline scenario (primary fiscal balance, interest rate, and growth rate) would be expected, particularly if a large fiscal adjustment is required to ensure sustainability. **II. Level of public debt as one of the triggers for further analysis:** Although a DSA is a multifaceted exercise, the IMF (2011) emphasizes that not only the trend but also the level of the debt-to-GDP ratio is a key indicator in this framework. IMF (2011) does not find a sound basis for integrating specific sustainability thresholds into the DSA framework. **III. Analysis of fiscal risks:** sensitivity analysis in DSAs should be primarily based on country-specific risks and vulnerabilities. **IV. Vulnerabilities associated with the debt profile:** IMF (2011) proposes to integrate the assessment of debt structure and liquidity issues into the DSA. **V. Coverage of fiscal balance and public debt:** This should be as broad as possible, with particular attention to entities that present significant fiscal risks, including state-owned enterprises, public-private partnerships, and pension and health care programs.

² http://siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1170954447788/3430000-1358445852781/KB_DSf.pdf (Accessed: June 28, 2018).

Substantial literature regarding fiscal sustainability exists, among which Bohn (1998) proposed a fiscal sustainability test to estimate the transversality 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 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 heteroscedasticity. The most credible evidence in favor of sustainability is the robust positive response of primary surpluses to fluctuations in the debt-to-GDP ratio. Chalk and Hemming (2000) have provided an overview of approaches to assess fiscal sustainability. They summarized the general analytical background, focusing on the present value budget constraint, which is the benchmark against which solvency is determined, tests of sustainability (including sustainability indicators), and sustainability and uncertainty. They also discuss the links between fiscal and external sustainability. Baharumshah, Soon and Lau (2017) have proposed a Markov-switching model to assess the sustainability of fiscal policy in Malaysia for the period 1980–2014. Their results reveal that the government should cut the deficits only if they exceed a certain level, in order to ensure their sustainability in the long term. Specifically, they find that once public debt exceeds a certain threshold level (above 55% of the gross domestic product), it is negatively correlated with economic activity. In addition to the threshold effect, they confirm the presence of a unidirectional causal relation between debt and growth.

In the case of Japan, numerous empirical studies also exist. A study by Yoshino and Mizoguchi (2010) investigates the role of the Liberal Democratic Party (LDP) 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, following the bursting of the economic bubble in 1990, the country fell into a long economic malaise, called the “lost decade.” Considering the current JGB circumstances in Japan, they introduce a stability condition for the government bond market by accounting for government supply and the demand for government bonds by financial institutions. McNelis and Yoshino (2012) have 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 real and nominal variables. Yoshino and Mizoguchi (2013) have investigated the features of the flow of funds in Japan over time. They demonstrate 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) have 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 that of Greece. In Japan, a large share of government debt is held domestically, substantial central bank holdings of government debt exist, and autonomous monetary policy can be used to ease a financial crisis. Based on their model analysis, they show why Japanese domestic investors hold such huge amounts of JGBs. Hoshi and Ito (2014) have used a simulation method to assess whether Japan’s budget deficits are sustainable and concluded that Japan’s fiscal situation is in a dangerous zone. In a more recent study, Ko and Morita (2015) have examined fiscal sustainability conditions in the Japanese economy, estimating a Markov-switching vector autoregressive (VAR)

model. Ko and Morita identified three fiscal sustainability conditions in one VAR model: the stance of the government, Domar (1944)-type GDP growth, and other factors.

Previous analyses such as by Bohn (1998, 2005) have 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. This paper presents a new stability condition for the bond market. We also present rules for fiscal stabilization and explain the fiscal rules corresponding to Taylor's rule for monetary policy.

3. MODEL

In this section, we present the Domar condition, a simple macroeconomic model, the revised Domar condition combined with the bond market, and the proposed fiscal policy rule and tax rule to achieve the sustainability of the budget.

3.1 Domar Condition

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.

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

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 obtain the Domar condition:

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

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, we obtain the Domar condition in Equation (2). If the interest rate is higher than the growth rate of the economy, the budget deficit will rapidly increase. 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 demand into account.

3.2 Simple Macroeconomic Model

We describe the equations for both supply and demand for government bonds based on the model set out by Yoshino and Mizoguchi (2010, 2013). Our model is summarized as follows. Government budget constraint is equal to the supply of government bonds:

$$G_t + r_t^B B_{t-1} = \Delta B_t^S + T_t + \Delta M_t \quad (3)$$

Demand for government bonds is given by:

$$\Delta B_t^D = b_0 + b_1 r_t^B \quad (4)$$

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 (6) is the disposable income. Disposable income is defined as income (Y_t) plus 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). Thus:

$$YD_t = Y_t - T_t + r_t^B B_{t-1} = C_t + S_t \quad (6)$$

where $S_t = \Delta B_t + \Delta M_t + \Delta W_t^D$.

Savings (S_t) = government bonds (ΔB_t) + money demand (ΔM_t) + domestic deposits (ΔW_t^D). The investment function is written as:

$$I_t = i_0 - i_1 r_t \quad (7)$$

The consumption equation³ is:

$$C_t = c_0 + c_1 YD_t \quad (8)$$

And the deposit equation is:

$$\Delta W_t^D = d_0 + d_1 YD_t + d_2 r_t \quad (9)$$

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 on government bonds. If the interest rate for government bond increases, households will want to buy more bonds and reduce the amount of deposits. All deposits are used for bank loans to satisfy investment.

From Equations (6)–(9), we derive the investment–savings balance equation:

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

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

$$\Delta W_t^D = I_t \quad (11)$$

³ We assume that the consumption function is a Keynesian consumption function, a non-Ricardian type. For the Ricardian type, see Kónya and Abdullaev (2014).

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

$$Y_t^* = \frac{1}{\Delta} \{ (d_1 + i_1)c_0 + d_1i_0 + i_1d_0 + (d_1 + i_1 + d_1i_1)G_t - ((d_1 + i_1)c_1 + d_1i_1)T_t + (d_1 + i_1)c_1 + d_1i_1 \} r_t^{B^*} B_{t-1} \} \tag{12}$$

$$r_t^* = \frac{1}{\Delta} \{ (1 - c_1)(i_0 - d_0) - d_1(c_0 + i_0) - d_1G_t + d_1T_t - d_1r_t^{B^*} B_{t-1} \} \tag{13}$$

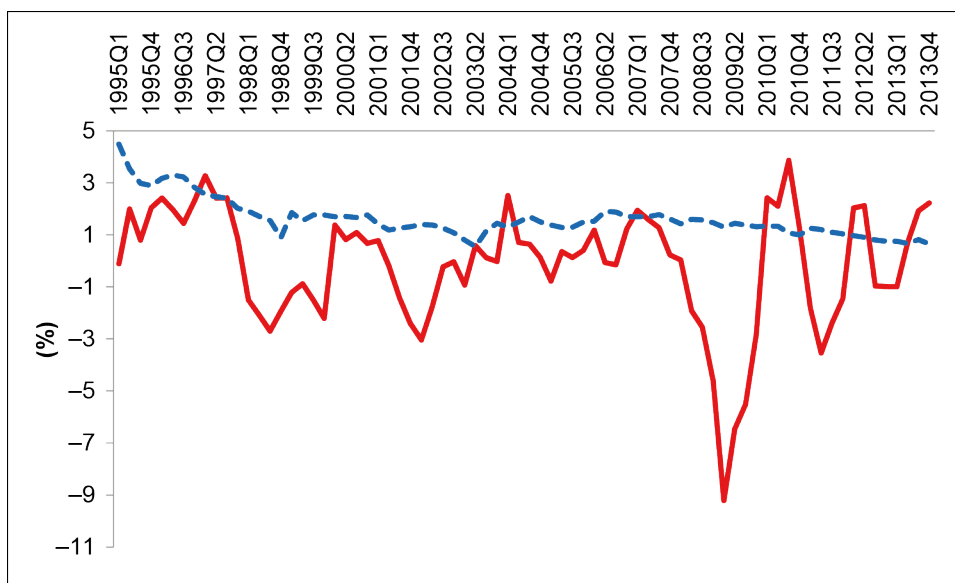
where $\Delta = (1 - c_1)(d_2 + i_1) - d_1i_1$ and $r_t^{B^*} = \frac{G_t - T_t - b_0 - \Delta M_t}{b_1 - B_{t-1}}$.

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

3.3 Revised Domar Condition Combined with the Bond Market

Figure 4 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 move approximately in conjunction. The figure shows that the rate of interest exceeds the growth rate of the economy. This 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 show 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. As both the interest rate and bond supply and demand are endogenous in our model, we can investigate the stability condition based on each economic variable in the economy.

Figure 4: The Real GDP Growth Rate and the Long-term Interest Rate in Japan



GDP = gross domestic product.

Note: The constant line is the real GDP growth rate; the dashed line is the long-term interest rate. 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.

3.4 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 smooth changes in government spending (G_t), taxation (T_t), and 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 in taxation (T_t):

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

The first-order conditions are:

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

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

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

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

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

The taxation rule is:

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

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

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 determine the desirable changes between GDP and the primary balance, but should also establish a rule for changes in both government expenditure and taxation. Furthermore, in implementing fiscal policy, it should not only check the difference between the GDP-to-debt ratio and the desirable GDP-to-debt ratio (Bohn's condition), but also the changes in government expenditure and taxation in the previous year, and the trend in the business cycle. Based on Equations (17) and (18), according to which 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 a default. Our proposed fiscal policy rules, an expansion of Bohn's condition, imply that in implementing policy governments should (a) establish strict control over issuing government bonds and (b) examine the business cycle for fiscal sustainability.

4. EMPIRICAL SURVEY

The empirical survey of this paper consists of two subsections. In the first subsection we study the impact of different macroeconomic variables on the demand for Greek government bonds. In the second subsection we calculate the optimal fiscal policy for Japan.

4.1 Case of Greece

In order to ascertain the macroeconomic determinants of demand for government bonds in Greece, we develop a simple econometrics model (Eq. 20) for our analysis:

$$B_t^{Grc} = C_0 + C_1(r_t^{Grc} - r_t^{Dew}) + C_2(y_t^{Grc}) + C_3(Debt_t^{Grc}) \quad (20)$$

Where B_t^{Grc} denotes demand for Greece government bonds, C_0 is the constant demand, r_t^{Grc} is the long-term Greek government bond interest rate and r_t^{Dew} is the German government bond interest rate, which is the benchmark interest rate in this study with zero default risk. Moreover, instead of solely using Greek government bonds' long-term interest rates, we use deviation of Greek long-term interest rate from the benchmark rate (German government bond interest rate). y_t^{Grc} denotes the Greek GDP level and $Debt_t^{Grc}$ denotes the Greek central government's accumulation of debt divided by Greece's GDP in nominal terms. C_1 ; C_2 ; C_3 are three coefficients of the three aforementioned regressions.

In order to run our regression, we used quarterly data from 2001 (when Greece adopted the Euro) until 2016. The definition of each variable and the source of data are stated in Table 2.

Table 2: Definition and Source of Variables

Variable Symbol	Definition	Source of Data
B_t^{Grc}	Logarithm of nominal value of the securities issued by the Greek central government (Greece government bond)	Statistics of Bank of Greece, Securities settlement system (BOGS)
r_t^{Grc}	Greek long-term government bond nominal interest rate	Organisation for Economic Co-operation and Development statistics (OECD 2018b)
r_t^{Dew}	German long-term government bond nominal interest rate	Organisation for Economic Co-operation and Development statistics (OECD 2018b)
y_t^{Grc}	Logarithm of the nominal GDP of Greece, seasonal adjusted	Organisation for Economic Co-operation and Development statistics (OECD 2018c)
$Debt_t^{Grc}$	Logarithm of Greek general government debt as percentage of nominal GDP	Organisation for Economic Co-operation and Development statistics (OECD 2018a)

Source: Authors.

Before running the regression, data analysis is required. In order to check for the presence of a unit root and evaluate the stationarity of all series, we performed the most popular unit root test, which is the augmented Dickey-Fuller (ADF) test. The results are summarized in Table 3.

Table 3: Unit Root Test Results

Variable	Augmented Dickey-Fuller (ADF)	
	Level (t-statistics)	First Differences (t-statistic)
B_t^{Grc}	-2.04	-7.04**
$(r_t^{Grc} - r_t^{Dew})$	-2.25	-4.18**
y_t^{Grc}	-1.90	-11.24**
$Debt_t^{Grc}$	-0.29	-7.71**

Note: ** indicates rejection of the null hypothesis for the presence of unit root at 1 percent.

Source: Authors compilation.

The results in Table 3 imply that all series have a unit root and are non-stationary in level. However, when running the ADF test on their first differences, we were able to reject the null hypothesis of presence of unit root and became stationary. Once the unit root test was performed and it was discovered that the variables are non-stationary in levels and stationary in first differences, they were integrated to the order 1 or I(1). Owing to the non-stationary series, the next step is to apply a cointegration analysis to examine whether the series are cointegrated and whether long-run relationships exist among these variables.

In the next step, in order to identify the cointegrating vectors among the four variables (GDP, debt/GDP, interest rate deviation and bond demand) we conduct a cointegration analysis using Johansen's technique.

The results of the cointegration rank test of trace and maximum eigenvalue are exhibited in Table 4.

Table 4: Cointegration Test Results

A) Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.46	63.91	47.86	0.00
At most 1	0.26	26.84	29.80	0.11
At most 2	0.10	8.16	15.49	0.45
At most 3	0.02	1.43	3.84	0.23
B) Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.46	37.07	27.58	0.00
At most 1	0.26	18.68	21.13	0.11
At most 2	0.10	6.70	14.26	0.52
At most 3	0.02	1.43	3.84	0.23

Note: * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values.

As is clear from Table 4, the above tests (both trace and maximum eigenvalue) reject the null hypothesis of non-cointegrating variables. This means that all variables are cointegrated and a long-run association exists among variables. In other words, in the long run, these four variables move together. Hence for running the regression we select a cointegration regression method of fully modified least squares (FM-OLS), as in Phillips (1993).

In checking the series, we found outliers in all four variables, hence we added four dummy variables. The supply of government bonds in Greece in 2009 experienced a drastic increase in comparison to 2007 and 2008 following the global financial crisis, which forced the government to increase expenditure while the Greek economy was in recession. The deviation of the Greek bond interest rate from the German bond interest rate is significantly high in 2011 and 2012 as shown earlier in Figure 3. This deviation in 2012 Q2 reached a peak of 24%. The nominal GDP growth rate of Greece in 2009 Q1 dropped drastically and was -4.7% , and finally the government debt/GDP in 2011 dropped to roughly the same level as the previous year. However, in 2012 it started to increase. An outlier can cause serious problems in statistical analyses. These outliers account for why we included four dummy variables to estimate the model (Eq. 20) by the FM-OLS method. The results of the FM-OLS regression are summarized in Table 5.

Table 5 reveals that the coefficient of the interest rate is negative and statistically significant. In conventional and normal cases this coefficient is expected to be positive. This accords with an upward slope demand for government bonds with respect to interest rate, hence when the yield of the bond increases, demand also rises. However, the Greek case is not typical, as we found a negative value for this coefficient. This means that although the interest rate of Greek bonds increased during the period of our analysis and in 2012 Q2 its deviation from the benchmark interest rate (German government bond) reached a peak of 24%, however this was not only due to eagerness among investors to keep Greek bonds, but also because many foreign individuals and institutional investors started to sell their holdings of Greek bonds as the credit risk increased. This is in line with the earlier explanations in Section 1. Second, our results show a significant association between the economic conditions (GDP growth rate) and the demand for government bonds. When the country is in

economic recession or when Greek GDP growth rate shows almost zero or negative rates, the demand for bonds shrinks, and many investors (especially foreign investors) withdraw their investments in the Greek bond market due to their negative expectations of the Greek economy. Finally, we could not find any significant association between the debt-to-GDP ratio and the demand for government bonds. Indeed, the debt-to-GDP ratio does not play any significant role in determining the demand for government bonds. This finding is in line with Chionis, Pragidis, and Panagiotis (2014), who did not find any significant role for the debt-to-GDP ratio in determining the demand for government bonds in Greece.

Table 5: FM-OLS Regression Results

Variable Symbol	Definition	Coefficient
$(r_t^{Grc} - r_t^{Dew})$	Deviation of Greek long-term government bond nominal interest rate from the benchmark interest rate (German long-term government bond nominal interest rate)	-0.73* (-2.42)
y_t^{Grc}	Logarithm of nominal Gross domestic product of Greece, seasonal adjusted	1.39* (2.59)
$Debt_t^{Grc}$	Logarithm of Greek general government debt as percentage of nominal gross domestic product (GDP)	-0.25 (-1.46)

R-squared = 0.82 and Adjusted R-squared = 0.80.

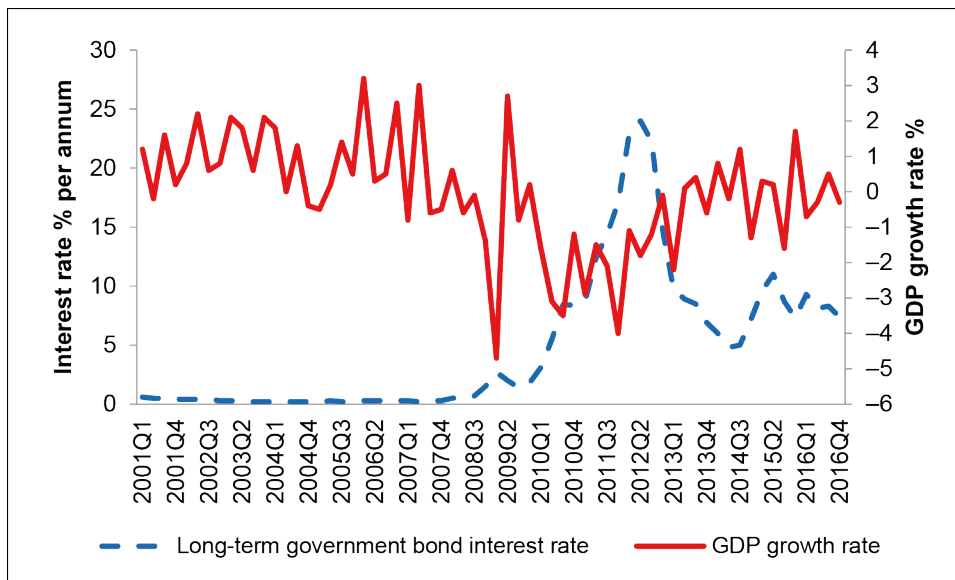
Note: dependent variable was B_t^{Grc} (Logarithm of Nominal value of the securities issued by the Greek central government (Greece government bond)), * denotes significance at the 5% level (p-value less than 0.05).

Source: Authors compilation.

Our findings revealing an insignificant association between debt/GDP and demand for government bonds is also in line with the current situation of Japan. Although the debt-to-GDP ratio is the highest in the world, given the country's economic strength, stability and creditworthiness, it has a low credit risk and both domestic and foreign investors show great interest in investing in Japanese long-term and short-term bonds (T-bills or Treasury bills). Hence it is very important to consider the determinants of the demand for government bonds, in line with the optimal fiscal policy rule proposed in this paper.

Figure 5 illustrates the GDP growth rate and the long-term government bond interest rate of Greece during 2001Q1–2016Q4. It is clear that following the global financial crisis of 2008 when the Greek economy was in recession, the GDP growth rate dropped from 0.6 percent per annum in 2008Q1 to -4.7 percent per annum in 2009Q1 on average. This period was when investors (especially foreign investors) in the Greek bond market asked for a higher risk premium due to the negative economic situation in the country and the uncertainty about the future of the Greek economy, and the demand in the Greek bond market has since shrunk. As a result, the interest rate started to hike sharply as indicated in Figure 5, which is in line with the results of the empirical survey in Table 5.

Figure 5: GDP Growth Rate and Long-term Interest Rate in Greece (2001Q1–2016Q4)



Note: The constant line is the nominal GDP growth rate seasonally adjusted; the dashed line is the long-term interest rate of Greek government bonds.

Source: OECD (2018b) and OECD (2018c).

4.2 The Case of Japan

For the case of Japan, we used quarterly data from Q1 1994 to Q4 2014, a period including 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.

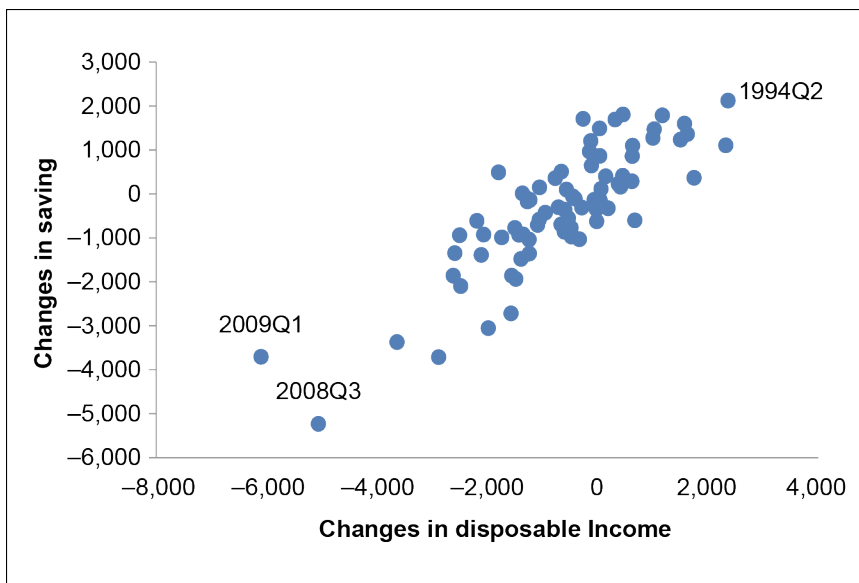
The government expenditure used in our empirical survey is the total public demand and tax is the total government tax revenue, both seasonally adjusted. Money demand is M2, the average amount of outstanding money stock based on year-on-year change. For the outstanding bonds we used the total outstanding 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.

In order 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. Johansen cointegration test could not find any cointegration among the series. 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 equation. 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

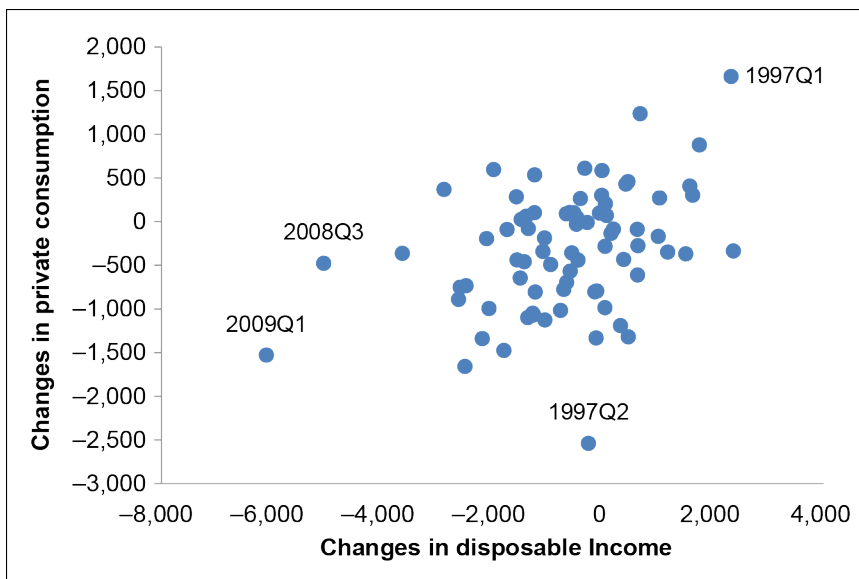


Note: Deposits = saving – demand for government bonds.

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

Source: Nikkei NEEDS.

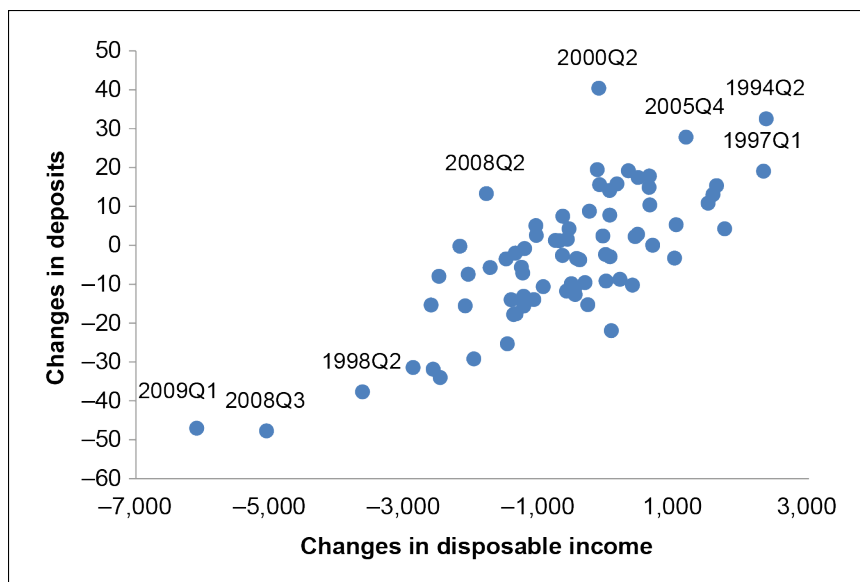
Figure 7: Changes in income versus private consumption



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.

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.⁴ Outliers are mainly during 2008 (global financial crisis) and the crises of the Japanese and Asian economies in 1997–98. As shown in Figure 7, Japanese households' consumption in addition to 2008–2009 (global financial crisis) in 1997–1998 fell. In addition to the Asian financial crisis in 1997, another reason behind the drop in consumption is the tax hike of April 1997. The Japanese economy became extremely fragile after the failure of two large financial institutions in November 1997. Uncertainties about the future of the banks and other financial institutions depressed the stock prices, which in turn put pressure on bank balance sheets. This forced banks to curtail lending, exacerbating the macroeconomic conditions and consumption level (Ito 1999). Standard counter-cyclical macroeconomic policies did not seem to work in Japan in the second half of the 1990s. Given that the interest rate fell to almost zero after that time (and has most recently been negative), and owing to the fact that the problems of the Japanese economy are more structural, the effectiveness of monetary policies is limited (Yoshino and Taghizadeh-Hesary 2015, 2017).

Consequently, we can 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 9 shows the past actual government spending and tax revenue of the Japanese

⁴ Below are the results of the regressions:

$$\text{Eq. 4: Demand for government bonds: } \Delta(B_t) = 8,444,390 + 1,336,455(r_t)$$

$$\text{Eq. 7: Investment function: } \Delta(I_t) = 85,153 - 2,125[\Delta(r_t)]$$

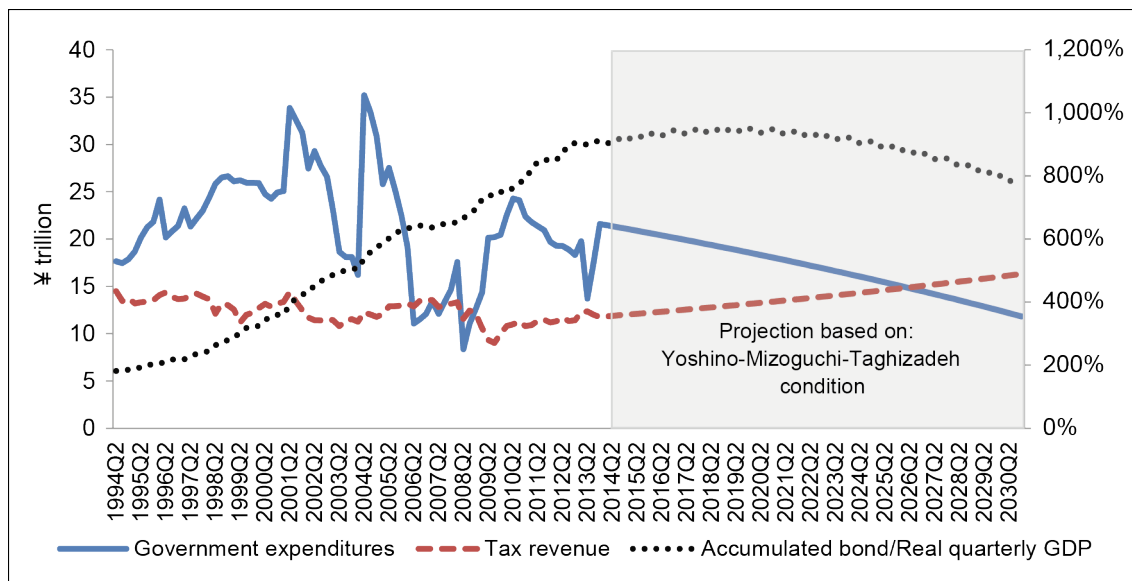
$$\text{Eq. 8: Consumption equation: } C_t = 9,445 + 0.53(YD_t)$$

$$\text{Eq. 9: Deposit equation: } \Delta(W_t^D) = -10,828,237 + 0.22(YD_t) - 67,5616(r_t)$$

Equation 8 shows the marginal propensity to consume to be 0.53.

government (Q2 1994–Q4 2013) and the projected government spending and tax revenue (Q1 2014–Q4 2030) based on our model.

Figure 9: Government Expenditure and Tax Revenue (Quarterly Data)



Note: The gray shaded area indicates the projected values based on Yoshino-Mizoguchi-Taghizadeh condition. The left-hand axis indicates government expenditures (primary expenses) and tax revenue both quarterly values, 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 8, in order to act as per the optimal fiscal policy rule provided in this paper and to reduce the amount of national debt from its present high level, Japanese government expenditure needs to be drastically reduced and the government tax revenue must shift upward. This means that both sides of the budget need to be adjusted simultaneously (expenditure and revenue) in order to achieve fiscal sustainability. Furthermore, as is apparent from this figure, the reduction in expenditure needs to be greater than the increase in revenue. According to our calculations for 2014–2030, the Japanese government needs to cut expenditure by 45% and raise tax revenue by 38% in order to attain fiscal sustainability. For this to occur, the accumulated government bonds-to-real GDP ratio needs to be reduced from 228% in Q4 2013 to 196% in Q4 2030. Our results contrast with those of Jones and Fukawai (2017), who argue that much of the consolidation has to be on the revenue side, primarily through hikes in the consumption tax rate toward the OECD average and a broadening of the personal income tax base. We believe that if more focus were to be placed on the revenue side of the government budget by increasing tax, the Japanese economy will be pushed further into economic recession due to the reduction of the consumption level.

5. CONCLUSION

This paper addresses how the conventional Domar condition for the stability of the budget is obtained only from the supply side for government bonds: the government budget condition. It argues that it is also important to consider 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. In contrast, 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 presents the condition to retain the budget balance, the optimal fiscal policy condition must be obtained. The optimal fiscal policy condition should 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 condition obtained in this paper satisfies the conditions for both the stability of the budget and the recovery of the economy at the same time.

The fiscal policy condition proposed in this paper, which is the expansion of Bohn's condition, shows that to achieve fiscal sustainability, governments should (a) establish strict controls over issuing government bonds, and (b) examine the business cycle for fiscal sustainability.

Consequently, in the empirical analysis for the case of Greece, the paper could not find a significant association between the debt-to-GDP ratio and demand for government bond. This is also true of Japan. Although Japan's debt-to-GDP ratio is the largest in the world, owing to its economic strength, stability and creditworthiness, this has resulted in a low credit risk level, and both domestic and foreign investors are showing interest in demanding long-term and short-term bonds (T-bills or Treasury bills). This means that it is critical to consider the determinants of the demand for government bonds, in line with the optimal fiscal policy rule proposed in this paper. In addition, in the case of Greece, we found a negative significant association between the long-term government bond interest rate and demand for government bonds. This intimates that investors are in the first step not seeking higher yields, but they see the risk of investment and the need to secure investment as important, and as a subsequent priority they look for yield. Although the interest rate on Greek government bonds reached beyond 20% in 2012, due to the risk of investment and instability of the Greek economy, foreign investors did not increase their demand for Greek bond and even withdrew their investments, causing the Greek bond interest rate to increase beyond 29% per annum.

In the case of Japan, our results show that in order achieve fiscal sustainability based on the optimal fiscal policy condition proposed in this paper, both sides of the Japanese government budget (expenditure and revenue) need to be adjusted simultaneously. The results show that in order to secure economic growth, the decline in government expenditure must exceed the increase in tax revenue.

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