

## Change in the Flow of Funds and the Fiscal Rules Needed for Fiscal Stabilization<sup>\*</sup>

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### Abstract

Here we explain the features of the flow of funds in Japan across time by using the flow-of-funds table. We prove that the volume of the flow of funds has decreased in various sectors compared with the boom period of the 1980s. Especially in recent years, an increased volume of corporate savings, thanks to an increase in the overseas income balance, has been deposited as liquid savings and used to purchase government bonds through financial institutions. On the other hand, the volume of the flow of funds from financial institutions to corporate investments has reduced dramatically recently.

We then move on to focus on the differences between the Greek and Japanese government bond markets. Although Japan's government debt ratio to GDP is bigger than that of Greece, the Japanese government bond market has remained stable. We take note of the demand side of government debt, and explain the differences between the Japanese government bond market, which enjoys a big demand from the domestic financial institutions and investors, and the Greek one, which relies heavily upon foreign investors for demand. We also explain the difference in the stabilizing measures of government bond markets between the two countries by using demand-side analysis.

We point out that the Domar condition, which has so far led the discussion about the stabilization of government bond markets, was derived only from the supply-side analysis of government bonds, and thus does not always prove to be valid. Instead, we derive the stabilizing conditions for government bond markets from a model which considers government bond demand. We also present some rules for fiscal stabilization and explain the fiscal rules corresponding to Taylor's rule for monetary policy. Finally, we conclude that the issuance of a large volume of debt-covering government bonds should be restrained, and that Japan's funds should be guided to contribute to the accumulation of private capital stock for the recovery of the growth of the Japanese economy, and we conduct model analysis regarding its appropriate levels.

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Keywords: Government Bond Markets, Fiscal Rules, Fiscal Stabilization

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The purpose of this paper is to examine the flow of funds in Japan among various sectors across time. It can be seen that most of the funds are directed to the government sector due to huge issues of government bonds.

The second purpose of the paper is to analyze the government bond market in terms of both the supply and the demand for government bonds by use of simple general equilibrium. The paper proposes a new fiscal rule in order to avoid fiscal explosion.

The third objective is to examine the effect of huge reliance on government bonds in the context of a simple growth model and to show the importance of directing funds to the private sector for the accumulation of private capital, in order to achieve the economic recovery of Japan.

## **I. Flow of Funds from the Bubble Period of the 1980s to the Current Period**

### *(1) The Financial Surplus and Deficits of the Various Sectors in Japan*

The following figures show changes in the financial flow of Japan by use of the flow of funds table of the Central Bank of Japan. Tables (1) to (3) denote the flow of funds from left hand column sectors to horizontal top row sectors of various periods. These figures show the annual yearly average of various periods.

The figure is obtained from the stock table of the flow of funds table by taking yearly difference. The authors modified the original flow of funds table into nine economic sectors and 48 financial products by aggregation.

The nine economic sectors are CB (Central Bank of Japan), PFI (Private Financial Institutions), PS (Postal Savings), GFI (Government Financial Institutions), PRFirm (Private Non-financial Firms), PUFirm (Public Non-financial Firms), GOV (Government Sector which includes Central Government, Local Government and Social Security Funds), HH (Households), ROW (Rest of the World) and Total (Sum of Each Rows).

Main changes in the financial flow of various periods will be explained as follows;

Table (1) 1980—1990 (Includes the Bubble Period) Source: BOJ Flow of Funds

	CB	PRFI	PS	GFI	PRFirm	PUFirm	GOV	HH	ROW	Total
CB	0	1.09	0	0	0	-0.07	1.55	0.02	0.09	2.69
PRFI	0.80	<b>42.83</b>	0	1.49	<b>40.61</b>	1.70	<b>5.07</b>	<b>14.38</b>	<b>13.48</b>	<b>120.37</b>
PS	0	0.03	0	<b>7.65</b>	0	0	0.76	0	0	8.44
GFI	0.21	1.70	1.04	<b>4.72</b>	2.17	1.29	<b>7.47</b>	3.72	0.45	22.77
PRFirm	0.78	15.36	0	0.33	<b>27.25</b>	0.45	0.47	2.31	5.40	52.35
PUFirm	0.08	0.77	0	0	0	-0.07	-0.10	-0.11	0	0.57
GOV	0.07	5.05	0	<b>6.22</b>	4.00	0.34	0.49	0.18	0.86	17.20
HH	1.02	<b>45.21</b>	<b>7.50</b>	0.28	9.69	0.36	0.73	0.15	0.99	65.93
ROW	0	10.07	0	0.19	4.88	0.68	0.37	0.77	1.78	18.74
Total	<b>2.96</b>	<b>122.11</b>	<b>8.54</b>	<b>20.88</b>	88.61	4.68	<b>16.82</b>	21.42	23.04	

Table (1) 1980—1990 (includes the Bubble period) shows how much money had flown as a net figure from left hand vertical sector to the top horizontal sector in each year on average from 1980 to 1990.

The second row of Table (1) shows that financial institutions had exchanged 42.83 trillion yen between each other in this period. From PRFI to PRFirm 40.61 trillion yen was supplied mainly in the form of private bank loans to finance investments etc. The household sector borrowed about 14.38 trillion yen from PRFI for housing loans and auto loans etc. 13.48 trillion yen was invested in overseas during this period. In total, PRFI invested 120.37 trillion yen on average during the 1980-1990 period. The real GDP of this period was about 450 trillion yen.

Row 5 of Table (1) denotes how PRFirm had been used their assets (PRFirm holds shares of other companies and trade credits were used on regular basis to help SMEs, between firms, 27.25 trillion yen had been transacted) PRFirm managed their assets totaling 52.35 trillion yen.

The households sector put 45.21 trillion yen into PRFI as a form of deposits insurance, etc. They deposited 7.50 trillion yen to the post office as postal savings. Purchase of stocks and bonds were about 7.50 trillion yen. Households saved about 65.93 trillion yen on average in this period as is shown in the last column.

The bottom row of Table (1) denotes how much each sector borrowed from various sector, PRFI absorbed the largest amount of money from the various sectors and it amounted to 122.11 trillion yen. The second largest absorber of funds was PRFirms (88.61 trillion yen). The government sector absorbed only 16.82 trillion yen during this period.

Table (2) 1990–2000 (Post Bubble Period) Source: BOJ Flow of Funds

	CB	PRFI	PS	GFI	PRFirm	PUFirm	GOV	HH	ROW	Total
CB	-1.34	-2.36	0	2.01	0	0	4.72	0.03	0.36	3.42
PRFI	3.38	-2.55	-0.15	4.88	-1.37	-4.14	7.79	1.67	17.05	26.56
PS	0.37	-0.38	0	-25.42	-2.00	-0.34	13.59	0.03	-0.23	-14.39
GFI	-0.01	0.59	-4.34	-9.91	-2.61	-2.00	-4.42	-5.39	-0.11	-28.18
PRFirm	0.07	10.78	0	0.78	19.83	0.25	1.00	0.28	4.08	37.06
PUFirm	-0.38	-0.04	0	0	0	0	0	0	0	-0.42
GOV	-2.71	0.06	0	-13.73	4.76	-1.90	10.48	-0.05	13.54	10.46
HH	-0.18	14.88	-9.97	1.60	11.06	-0.43	2.98	0.02	-0.46	19.50
ROW	0.37	6.78	0	1.14	13.06	0.00	0.62	-0.30	2.15	23.82
Total	-0.43	27.77	<b>-14.45</b>	<b>-38.66</b>	42.74	-8.56	<b>36.76</b>	-3.70	<b>36.36</b>	

Table (2) (1990-2000) shows a quite different picture of the financial flow compared with the period of 1980-1990. The second row of Table (2) shows that PRFI (private financial institutions) are redeeming their outstanding assets from other PRFIs. Net decline in mutual funding among PRFI is -1.14 trillion yen. Private firms (PRFirm) are returning their money raised from PRFI by -7.23 trillion yen. The largest asset supply to PRFI is the government (21.71 trillion yen). PRFI are purchasing government bonds which keeps the stability of the government bond market in Japan. The last column of Table (2) shows total asset supply by each sector. The last column of the second row is 22.10 trillion yen which is about 1/6 of the 1980s. Row 5 of Table (2) is PRFirm (private non-financial firms). Decline in mutual share holdings attributed a sharp decline in financial flows among PRFirms (-11.13 trillion yen). In the 1980s, PRFirms were investing 52.35 trillion yen annually on average, however their asset management diminished to -9.31 trillion yen. This indicates that PRFirms are not investing but rather withdrawing their managed assets.

Row 8 is the households' sector. Households' asset allocation to banks and other financial institutions (PRFI) declined to 14.88 trillion yen from 27.33 trillion yen in the 1980s.

The last row of Table (2) shows how much assets each sector absorbed from the various sectors in 1990-2000. The government sector absorbed 41.75 trillion yen from the Private non-financial firms (PRFirms), which was the largest absorber of funds in all the Japanese sectors in the 1990-2000 periods, by issuing government bonds. PRFirms reduced their borrowings and stock issues by 18.45 trillion yen annually on average. Government financial institutions absorbed much more money (27.06 trillion yen) than private financial institutions (25.13). Row 2 shows that PRFI supplied 3.44 trillion yen for housing (to the households' sector) and GFI supplied 3.69 trillion yen for households (Row 4). The government housing loan corporation expanded their housing loans in order to cope with

the collapse of the Bubble.

Table (3) 2000—2006 (Period of Temporary Recovery) Source: BOJ Flow of Funds

	CB	PRFI	PS	GFI	PRFirm	PUFirm	GOV	HH	ROW	Total
CB	0.91	3.83	0	0.44	0	0	1.73	-0.02	0.08	6.97
PRFI	0.83	-1.14	0.31	1.58	-7.23	1.60	21.71	3.44	1.00	22.10
PS	0.00	0.25	0	11.20	1.20	0.31	2.97	0	0.71	16.63
GFI	-0.09	-0.28	4.23	5.59	1.91	0.82	11.05	3.69	0.94	27.85
PRFirm	0.78	-1.95	0	0.12	-11.13	0.46	0.42	0.28	1.70	-9.31
PUFirm	0.13	0.07	0	0	0	0	0	-0.02	0	0.17
GOV	2.13	1.54	0	8.04	0.56	1.04	0.48	-0.28	3.30	16.80
HH	1.41	27.33	11.41	-0.07	-5.36	0.03	1.12	0.10	0.31	36.27
ROW	0.00	-4.51	0	0.16	1.59	-0.51	2.28	-0.31	0.19	-1.11
Total	6.11	<b>25.13</b>	<b>15.95</b>	<b>27.06</b>	<b>-18.45</b>	3.75	<b>41.75</b>	6.87	8.22	

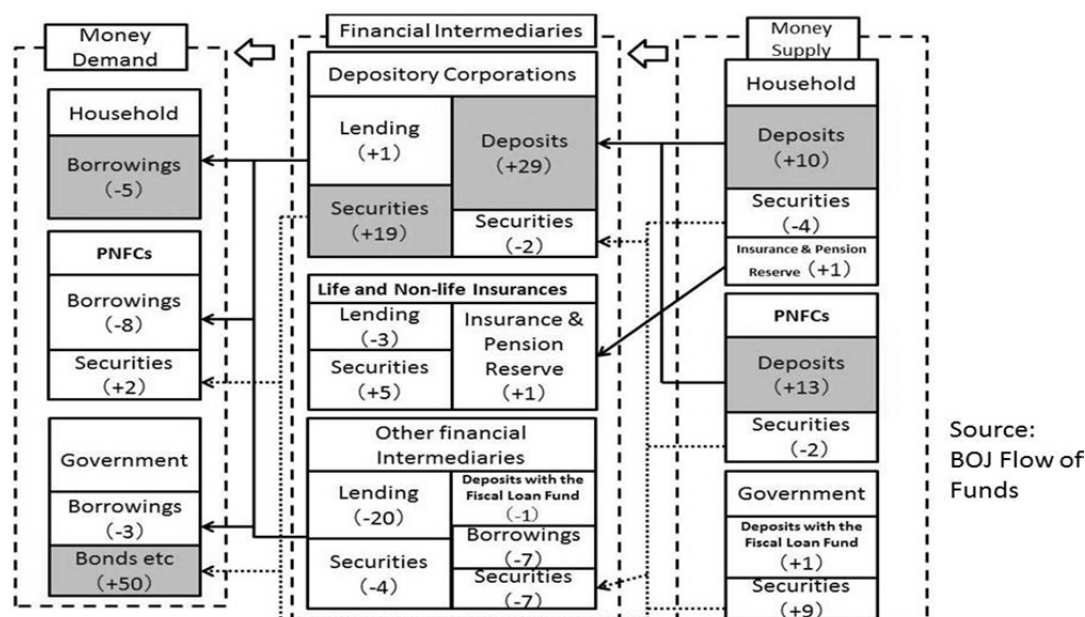
Table (3) shows the financial flows of 2000-2006, when the Japanese economy recovered temporarily due to the depreciation of Japanese yen. The most notable behavior was regarding the postal savings (PS) and government financial institutions (GFI). The figures for both became negative (-14.45 and -38.66), as can be seen in the last row of Table (3).

By the reform of postal saving system, PS started to invest in government bonds rather than supplying its collected deposits into the Fiscal Investment and Loan Program of the Ministry of Finance (Cargill and Yoshino (2003)). PS supplied 13.59 trillion yen of their money to the GOV by purchasing government bonds.

The total amount of supply of loans by government financial institutions (GFI) turned negative (-28.18 trillion yen), as is shown in the last column (Row 4). The housing loan corporation was abolished and it stopped direct lending of housing loans to the households' sector.

The depreciation of the Japanese yen during this period increased corporate profits and their asset allocation increased to 37.06 trillion yen, as is shown in the last column (Row 5). Private firms (PRFirms) absorbed 42.74 trillion yen due to expansionary business activities (last row of Table (3)). The government sector kept on borrowing at 36.76 trillion yen annually. Households returned their housing loans as a net figure (-3.70 trillion yen, last row).

Figure (1) The Recent Financial Flow in Japan (2010)



There are three blocks in Figure (1). The right hand column is the supply of funds. The middle column shows financial intermediation. The left-hand column is sectors which absorb funds.

The supply of funds comes from households, such as deposits (+10 trillion yen in 2010). However, households have reduced their securities investments by 4 trillion yen. Insurance and pension reserves from households have increased by 1 trillion yen. Private firms have increased their deposits by 13 trillion yen and reduced their securities investments by 2 trillion yen. Private non-financial firms collected their money from overseas' production and put their money mainly into ordinary deposits. Securities' investment declined due to downward trend of stock prices in Japan.

The block for financial intermediaries in Figure (1) shows how deposit taking institutions have increased their deposits by 29 trillion yen, which is the largest increase among various financial products. Insurance and pension reserves increased by only 1 trillion yen, due to the increase in retired people who have started to withdraw reserved pension funds.

Deposit-taking institutions such as banks increased their loans by only 1 trillion yen. Instead they increased their purchase of government bonds. Insurance and pension reserves reduced their loans by 3 trillion yen and increased securities (mainly the purchase of government bonds) by 5 trillion yen.

The left column of Figure (1) is the ultimate user of savings from households and private firms. Households returned 4 trillion yen of their borrowed money (mainly housing loans). Private firms reduced their bank loans by 8 trillion yen, due to sluggish investment

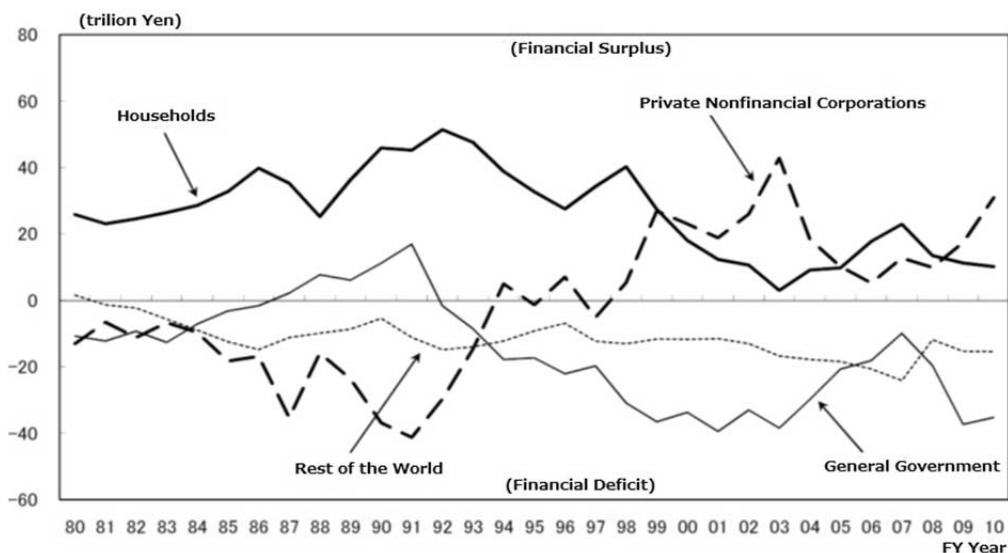
activities. The general government issued government bonds (both central government bonds and local government bonds) of 50 trillion yen. The government sector became the largest absorber of savings in Japan and the money is directed to aged people, central to local government allocation, interest payments on government bonds etc. Private firms do not invest and capital formation does not occur in Figure (1).

Figure (2) describes the surplus and deficits of (1) households, (2) Private non-financial firms, (3) general government, and (4) the overseas' sector. In the 1980s, households were the largest savers. Private non-financial firms were the largest borrower of funds. However, private corporate firms showed a surplus in their accounts from the mid-1990s, since they did not borrow money for investment. The general government became the largest absorber of funds due to the high deficits of the government. Textbooks explain that private savings ( $S$ ) are directed to domestic firms for investment ( $I$ ). However, the Japanese money flow shows that private savings ( $S$ ) are directed to the government ( $G$ ) by purchasing government bonds.

The current financial flow in Japan will face serious problems caused by the explosion of government debt and the burden of budgets being transferred to future generations. These money flows will not be easy for the economy to recover from, and instead they may bring Japan into an unstable path of Japanese budgets deficits.

Budget rules must be established in many countries which are facing huge budget deficits (Section 3), in order to sustain a stable fiscal situation. Section 4 determines the necessity of the accumulation of private capital stock in order to achieve continuous economic growth to compensate for the ageing population.

Figure (2) Surplus and Deficits of Various Sectors in Japan



Source: Bank of Japan

## II. The Unstable Path of the Current Budget deficits and the Necessity to Establish Fiscal Policy Rules

### II-1. Ricardian Equivalence Does Not Hold in Japan

Ricardian neutrality implies that huge current budget deficits imply an increase in future taxes. If consumers expect taxes to rise in the future, they will reduce their consumption to cope with the future increase in taxes. However, Japanese consumption shows very stable movement and it does not show any remarkable decline. People in Japan seem not to be taking into account an expected future increase in tax. Instead, they seem to believe the tax increase will be implemented in a future generation, rather than in their own time.

Another common view is that Japanese government debt is mainly held by domestic investors such as banks, insurance and pensions, which is very different from the case of Greece where 60% of their government debt is held by overseas' investors.

### II-2. Stability Conditions for Sustainable Budget Deficits

#### II-2-1. The Domar Condition

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

The Domar condition is obtained from government budget constraints as follows.

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

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

Divide Equation (1) by GDP ( $Y_t$ ) and rewrite Equation (1) will become

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

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

If  $r_t > \eta_t$  then  $b_t$  will become larger and larger, namely the budget deficits explode.

If  $r_t < \eta_t$  then  $b_t$  will become small and smaller namely the budget deficits converge.



## II-2-2. The Bohn's Condition (1998): To Check the Stability of Budget Deficits

The Bohn's condition can be obtained as follows.

$$PB_t = g_t - t_t \quad \text{Primary Balance of Public Finance (PB)} \quad (3)$$

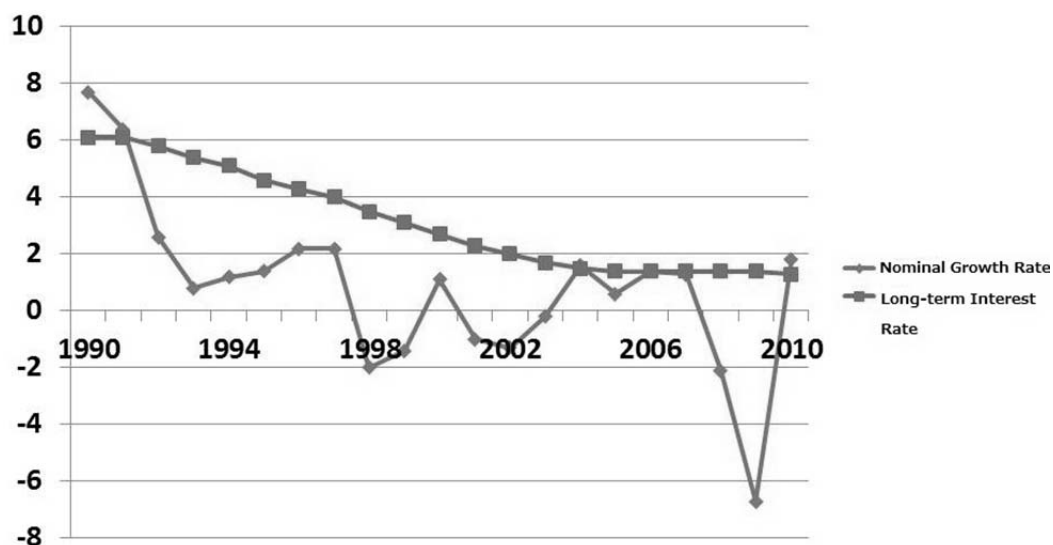
$$PB_t = PB_1 + \mu(b_{t-1} - b_0) \quad \text{Primary Balance Improvement Rule in Period } t$$

(The Bohn's Condition) <sup>1</sup>(4)

where  $\mu > 0$ , the Bohn's condition in Equation (4) describes that the primary balance must improve based on an increase in the levels of debt/GDP ratio ( $b_{t-1} - b_0$ ). In other words, either a reduction of government spending or an increase in tax revenue based on an increase in the level of government debt/GDP will lead to the stability of budget deficits.

Figure (3) shows that the rate of interest exceeds the growth rate of the economy. It suggests that Japanese budget is on an unstable path, based on the Domar condition.

Figure (3) A Comparison between the Economic Growth Rate ( $\eta_t$ ) and Interest Rate ( $r_t$ ) in Japan



Source: MOF and Ministry Cabinet

<sup>1</sup> By  $PB_t = PB_{t-1} + \mu(b_{t-1} - b_{t-2})$ , we recursively apply the primary balance improvement rule before period  $t-1$ , and therefore derive Equation (4). When the Bohn's condition is satisfied, we can show that the No Ponzi Game condition and this primary balance improvement rule are equivalent. i.e.  $\sum_{t=1}^{\infty} \frac{PB_t}{\lambda^t} = b_0$ , where  $\lambda = \frac{1+r_t}{1+\eta_t}$ . See Bohn (1998) for details.

### II-3. Government Debt: A Comparison between Japan and Greece

Figure (4) compares the debt to GDP ratio of selected OECD countries. Japan's debt/GDP ratio is the highest among OECD countries, yet the budget deficits are still sustained. On the other hand, the Greek government debt/GDP ratio is lower than that in Japan. However, Greece went into bankruptcy. Many Europeans ask why Japan is still sustained and Greece and other European countries are in serious trouble.

The differences between Japan and Greece can be seen in the demand for government debt, rather than supply of government debt. More than 90% of Japanese government debt is held by domestic investors. On the other hand, about 70% of Greece government debt is held by overseas' investors.

Figure (4) The GDP/Debt Ratio of Selected OECD Countries

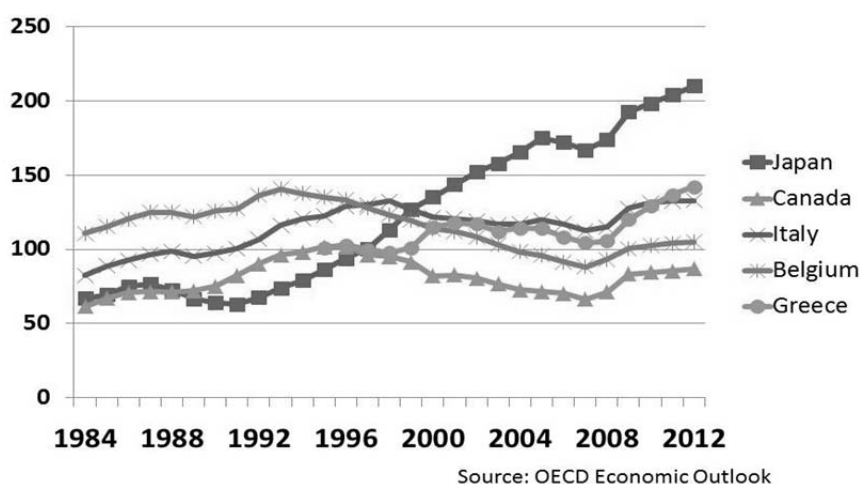


Table (4) Japanese Debt: 95% is held by Domestic Investors (2011)

HOLDERS	%
Banks and Postal Savings	45%
Life and Non-life Insurances	20%
Public Pension funds	10%
Private Pension Funds	4%
Central Bank of Japan	8%
Overseas' Investors	5%
Households	5%
Others	3%

Source: MOF

Table (5) Greek Debt: 70% is held by Overseas' Investors (2011)

HOLDERS	%
Overseas' Investors	33%
Greek Domestic Investors	21%
ECB	18%
Bilateral Loans	14%
Social Pension Funds	6%
IMF	5%
Greek Domestic Funds	3%

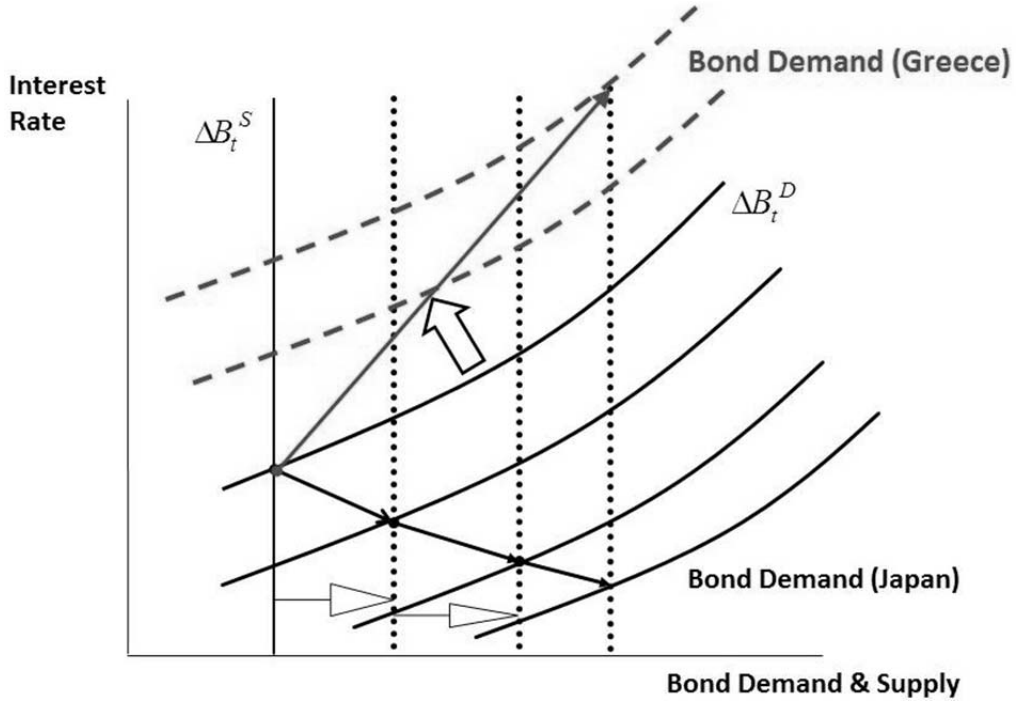
Source : Financial Times

Figure (5) describes the supply of government debt and the demand for government debt. The vertical line shows the supply of government bond in the primary market. No matter what the rate of interest is, the government has to finance its budget deficits. Therefore the supply of the government bonds is vertical in the primary market. The demand for government bonds increases when the interest rate rises. Thus the demand curve for government bonds is denoted as an upward sloping demand curve in Figure (5). Both Japan and Greece increased their government bond. The supply curve of the government bonds shifted to the right in the primary market.

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 etc. are looking for their investment. The sluggish economy in Japan has reduced the demand for corporate loans. Easy monetary policy has increased deposits of banks, etc. Banks have kept on receiving deposits and they are looking for investment in government bonds. Insurance companies face lower demand for corporate loans and they put much more money into government bonds. Public pension funds in Japan are inclined to invest in government bonds which are regarded as safe assets. Therefore the demand for government bonds has kept on increasing and the demand curve for government bonds is shifting to the right in Figure (5) (Japan). Japanese interest rate remains at a very low level.

The Greek case is entirely different (Table (5)). About 70% of investors in government bonds in Greece are overseas' investors. If they feel risk is involved in Greek bonds, they are very quick to sell on Greek bonds into the market. The demand for Greek bonds diminished when the risk of Greek bonds became eminent. The demand curve of Greek bonds has shifted to the left, as is shown in Figure (5), which raised the interest rate on Greek bonds higher and higher. The Greek interest rate went up by more than 20%, while the Japanese interest rate has remained at about 1% or less.

Figure (5) The Government Bond Market (Greece and Japan)



#### II - 4. A Fiscal Policy Rule Must be Established to Maintain Fiscal Discipline

Both the Domar condition and the Bohn's condition are obtained by using the supply of government bonds (namely using the government's budget constraints) without taking into account the demand for government bonds, which is shown in Figure (5). Both the supply of government bonds and the demand for government bonds have to be taken into account to explain the stability of the government bond market. The following section will address the fiscal policy rules needed to make government budget deficits in sustainable manner.

##### II-4-1. Government Objectives and a Fiscal Policy Rule to Achieve the Stability of Budget Deficits

The objective function of the government is set as follows.

$$L(B_t, Y_t, G_t) = \frac{1}{2}w_1(B_t - B_t^*)^2 + \frac{1}{2}w_2(Y_t - Y_t^f)^2 + \frac{1}{2}w_3(G_t - G_{t-1})^2 \quad (5)$$

The government aims to stabilize government debt ( $B_t$ ) as close as possible to its desired level ( $B_t^*$ ), GDP ( $Y_t$ ) as close as possible to its full employment level of GDP ( $Y_t^f$ ) and achieve smooth change of government spending ( $G_t - G_{t-1}$ ).  
where

$B_t^* = \frac{d_2(\bar{G}-\bar{T})}{(1-c_1-d_1)(Y_t^f-(1-\theta)\bar{G})+\bar{D}-(c_0+d_0)}$  is the desired level of government debt, which is the level that achieves the stability of government debt, where  $\bar{G}$ ,  $\bar{T}$ , and  $\bar{D}$  correspond to a steady state level of government expenditure, taxation, and deposit.

Minimize Equation (5) based on the following macroeconomic equations.

$$G_t + r_t B_{t-1} = \Delta B_t + T_t \quad \text{Government Budget Constraints} \quad (6)$$

$$YD_t = Y_t + \theta G_t + r_t B_{t-1} - T_t = C_t + S_t \quad \text{where } S_t = \Delta B_t + \Delta D_t \quad \text{and } 0 < \theta < 1 \quad (7)$$

Disposable income consists of income ( $Y_t$ ), government transfer ( $\theta G_t$ ), interest receipts of government bonds ( $r_t B_{t-1}$ ) minus tax payment ( $T_t$ ). Disposable income is divided into consumption ( $C_t$ ) and saving ( $S_t$ ). Savings are divided into demand for government bonds and deposits.

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

Consumption depends on disposable income.

$$D_t = d_0 + d_1 YD_t + d_2 r_t \quad \text{Deposit Equation} \quad (9)$$

Deposits depend on disposable income and interest rate.

From Equation (6) to (9), the equilibrium for the demand for government bonds and the supply of government bonds will yield an equilibrium interest rate as follows.

$$r_t^* = \frac{1}{(c_1+d_1)B_{t-1}-d_2} \times \frac{[(1-c_1-d_1)Y_t + D_{t-1} + (c_1+d_1)T_t - (1+(c_1+d_1-1)\theta)G_t - (c_0+d_0)]}{\text{Equilibrium interest rate of Government bonds}} \quad (10)$$

The optimal fiscal policy to avoid a budget explosion can be obtained by minimizing Equation (5) subject to the macroeconomic Equations (6)-(9). The fiscal policy rule to avoid budget explosion becomes the following.

$$G_t = a_0 + a_1 T_t + a_2 (B_t - B_t^*) + a_3 (Y_t - Y_t^f) + a_4 G_{t-1} + a_5 D_{t-1} \quad \text{Fiscal policy rule} \quad (11)$$

where

$$a_0 = - \left( \frac{\varphi_1(c_0 + d_0) + \varphi_2 Y_t^f}{((1-\varphi_1)(c_1 + d_1) - (1-\theta)\varphi_1)B_{t-1}} \right),$$

$$\begin{aligned}
a_1 &= \frac{\varphi_1((c_1 + d_1)(B_{t-1} - 1) - d_2)}{((1 - \varphi_1)(c_1 + d_1) - (1 - \theta)\varphi_1)B_{t-1}}, \\
a_2 &= \frac{\varphi_1((c_1 + d_1)B_{t-1} - d_2)}{((1 - \varphi_1)(c_1 + d_1) - (1 - \theta)\varphi_1)B_{t-1}}, \\
a_3 &= \frac{\varphi_2((c_1 + d_1)B_{t-1} - d_2) - \varphi_1(1 - c_1 - d_1)}{((1 - \varphi_1)(c_1 + d_1) - (1 - \theta)\varphi_1)B_{t-1}}, \\
a_4 &= \frac{\varphi_3((c_1 + d_1)B_{t-1} - d_2)}{((1 - \varphi_1)(c_1 + d_1) - (1 - \theta)\varphi_1)B_{t-1}}, a_5 = -\left(\frac{\varphi_1}{((1 - \varphi_1)(c_1 + d_1) - (1 - \theta)\varphi_1)B_{t-1}}\right).
\end{aligned}$$

and

$$\begin{aligned}
\varphi_1 &= \frac{w_1((1 - \theta)(1 - c_1 - d_1)B_{t-1} - d_2)}{[(c_1 + d_1)w_3 - w_1(1 - \theta)(1 - c_1 - d_1)]B_{t-1} + (w_1 - w_3)d_2}, \\
\varphi_2 &= \frac{w_2((c_1 + d_1)B_{t-1} - d_2)}{[(c_1 + d_1)w_3 - w_1(1 - \theta)(1 - c_1 - d_1)]B_{t-1} + (w_1 - w_3)d_2}, \\
\varphi_3 &= \frac{w_3((c_1 + d_1)B_{t-1} - d_2)}{[(c_1 + d_1)w_3 - w_1(1 - \theta)(1 - c_1 - d_1)]B_{t-1} + (w_1 - w_3)d_2}
\end{aligned}$$

Fiscal policy rules have to be established in more detailed manner to avoid the explosion of budget deficits.  $G_t$  in Equation (11) stands for the level of government spending for year  $t$ . It should be determined by the following items:

- (i) The amount of tax collected  $T_t$
- (ii) The gap between the current level of the actual budget deficits ( $B_t$ ) and its target value ( $B_t^*$ ) is set to 60% of GDP in Euro region
- (iii) The GDP gap ( $(Y_t - Y_t^f)$ ), the gap between the current GDP and full employment GDP
- (iv) The level of government spending in the previous year ( $G_{t-1}$ )
- (v) The level of wealth which can be directed to purchasing government bonds ( $D_{t-1}$ )

Fiscal discipline which follows Equation (11) must be strictly established to overcome the crisis.

### III. An Economic Growth Model which Takes the Government Bond Market into Account

This section will determine how much private capital stock is required to enable the Japanese economy to recover. A huge amount of money is directed to government bonds. Accumulation of private capital is needed for the economic recovery. An expanded Solow-Swan model which takes into account the supply and demand for government bonds will be analyzed in this section. The following model of the supply and demand for government bonds is based on Yoshino and Mizoguchi (2011).

$$G_t + r_t B_{t-1} = \dot{B}_t + T_t \quad \text{Government Budget Constraints (Bond Supply)} \quad (13)$$

$$Y_t - T_t + r_t B_{t-1} + \theta G_t = C_t + S_t \quad \text{where } S_t = \dot{B}_t + \dot{D}_t \quad \text{Bond Demand} \quad (14)$$

$$C_t = (1 - s)Y_t + G_t \quad \text{Consumption Equation} \quad (15)$$

$$D_t = d_0 + d_1 Y D_t - d_2 r_t \quad \text{Domestic Deposit Equation} \quad (16)$$

$$Y D_t = Y_t + \theta G_t + r_t B_{t-1} - T_t \quad \text{Disposable Income} \quad (17)$$

Here we simply assume that  $T_t = tY_t$ .

We can rewrite the demand for bonds (14) in the following form:

$$\dot{B}_t = Y_t + r_t B_{t-1} + \theta G_t - tY_t - C_t - \dot{D}_t \quad (18)$$

where  $r_t$  is the interest rate of bond and  $r_t B_{t-1}$  is total interest payments on government bonds.

From Equations (13) and (18), the equilibrium interest rate and outstanding government bond are obtained as follows.

$$r_t^* = \frac{1}{(c_1 + d_1)B_{t-1} - d_2} \times \left[ (1 - (1 - t)(c_1 + d_1))Y_t + D_{t-1} - (1 + (c_1 + d_1 - 1)\theta)G_t - (c_0 + d_0) \right] \quad (19)$$

$$B_t^* = \left[ \frac{(1 - c_1 - d_1)B_{t-1} + td_2}{(c_1 + d_1)B_{t-1} - d_2} \right] Y_t + \left[ \frac{B_{t-1}}{(c_1 + d_1)B_{t-1} - d_2} \right] D_{t-1} + B_{t-1} + \left[ \frac{(1 + (c_1 + d_1 - 1)\theta)B_{t-1}}{(c_1 + d_1)B_{t-1} - d_2} \right] G_t - \left[ \frac{B_{t-1}}{(c_1 + d_1)B_{t-1} - d_2} \right] (c_0 + d_0) \quad (20)$$

The production function in this model is assumed to be Cobb-Douglas type.

$$Y_t = F(K_t, L_t) = K_t^\alpha L_t^{1-\alpha} \quad (21)$$

Since the Cobb-Douglas production function is homogeneous to degree one, Equation (21) can be rewritten as follows.

$$Y_t = F(K_t, L_t) = L_t \cdot F\left(\frac{K_t}{L_t}, 1\right) = L_t \cdot F(k_t, 1) = L_t \cdot \phi(k_t) \quad (22)$$

where  $k_t = \frac{K_t}{L_t}$  (per capita capital) and  $n_t = \frac{\dot{L}_t}{L_t}$  (population growth rate).

Private savings are invested in deposits and government bonds. Bank deposits are loaned to corporations for their investment ( $I_t$ ) and government bonds are used for government spending.

$$sY_t = S_t = I_t + \dot{B}_t = \dot{K}_t + \dot{B}_t \quad (23)$$

In this model, total government spending ( $G_t$ ) changes based on the number of the retired population ( $N_t$ ), since the social welfare increases with the ageing of the population.

$$G_t = aN_t \quad (24)$$

The government budget constraints can be rewritten as follows.

$$\dot{B}_t = G_t - tY_t + r_t B_{t-1} = G_t - tY_t + r_t^* B_{t-1} \quad (25)$$

Equation (23) will be rewritten by substitution Equations (24) and (25),

$$sY_t = S_t = I_t + \dot{B}_t = \dot{K}_t + aN_t - tY_t + r_t^* B_{t-1} \quad (26)$$

Taking  $\dot{K}_t = \dot{k}_t L_t + k_t \dot{L}_t$  into account, Equation (26) will be changed into

$$sY_t = \dot{k}_t L_t + k_t \dot{L}_t + aN_t - tY_t + r_t^* B_{t-1} \quad (27)$$

By dividing the both sides of Equation (27) by  $L_t$

$$\dot{k}_t = (s + t)\phi(k_t) - n_t k_t - a \frac{N_t}{L_t} - r_t^* \frac{B_{t-1}}{L_t} \quad (28)$$

$$\dot{k}_t = (s + t)\phi(k_t) - n_t k_t - a \frac{N_t}{L_t} - r_t^* \frac{K_t}{L_t} \frac{B_{t-1}}{K_t} \quad (29)$$

By taking into account the following relations,  $\frac{N_t}{L_t} = \frac{N_t}{K_t} \cdot \frac{K_t}{L_t} = \frac{N_t}{K_t} k_t$ ,  $\rho_t = \frac{N_t}{K_t}$ ,  $\frac{N_t}{K_t} = \rho_t k_t$ ,  $\frac{B_{t-1}}{K_{t-1}} = b_{t-1}$  and  $\frac{K_t - K_{t-1}}{K_{t-1}} = g_k$  the Equation (29) will be rewritten as:

$$\dot{k}_t = (s + t)\phi(k_t) - n_t k_t - a \rho_t k_t - \frac{r_t^*}{1 + g_k} b_{t-1} k_t \quad (30)$$

Inserting  $\phi(k_t) = k_t^\alpha$  into Equation (30),

$$\dot{k}_t = (s + t)k_t^\alpha - n_t k_t - a \rho_t k_t - \frac{r_t^*}{1 + g_k} b_{t-1} k_t \quad (31)$$

the optimal capital stock is obtained as follows,

$$k_t = \left( \frac{n_t + a \rho_t + \frac{r_t^*}{1 + g_k} b_{t-1}}{(s + t)} \right)^{\frac{1}{\alpha - 1}} \quad (32)$$

where

$n_t$  = Growth Rate of Working Population (0.93(1985), 0.29(1995), -0.49(2005))

$a \rho_t$  = (Government Expenditures for Elderly People)  $\times$  ((Labor/Capital) ratio)



$$\frac{r_t^*}{1+g_k} b_{t-1} = (0.226 \times 0.15 \text{ (1985)}, 0.242 \times 0.24 \text{ (1995)}, 0.322 \times 0.32 \text{ (2005)})$$

$$\frac{r_t^*}{1+g_k} b_{t-1} = (\text{Interest Payments for Government Bonds}) / (1 + \text{Economic Growth Rate})$$

$\alpha$  = Capital Coefficient in Production Function (0.181)

$s$  = Savings Rate (0.197(1985), 0.186(1995), 0.074(2005))

$t$  = Marginal Tax Rate (0.160(1985), 0.149(1995) 0.143 (2005))

The optimal capital stock obtained in Equation (32) becomes

$$k_t = (7.906 \text{ (1985)}, 8.786 \text{ (1995)}, 9.187 \text{ (2005)})$$

This denotes that optimal private capital must rise to achieve high economic growth. It is urgently necessary to change flow of funds from government bonds to private capital formation, in order to achieve high economic growth.

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