Declined Effectiveness of Monetary Policy in the face of aging population and A Re-thinking of the Taylor Rule

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The purpose of this paper is to study how an aging population will affect economic performance by use of a New Keynesian dynamic stochastic general equilibrium model with heterogeneous households. The paper introduces two generation model by assuming gradual changes in aging population by use of continuous changes of the demography. It will be shown that a decline in working population will reduce aggregate output , consumption, and investment by reducing total labor supply in the long run. This paper finds that the effectiveness of monetary policy diminishes when the working population declines. This is the reason why Japanese economy had been suffering despite aggressive monetary policy in these years. East Asian countries are following to Japan fortheir aging population and Thailand will face with aging population. The study in this paper has to be taken into account for their monetary policy in future.

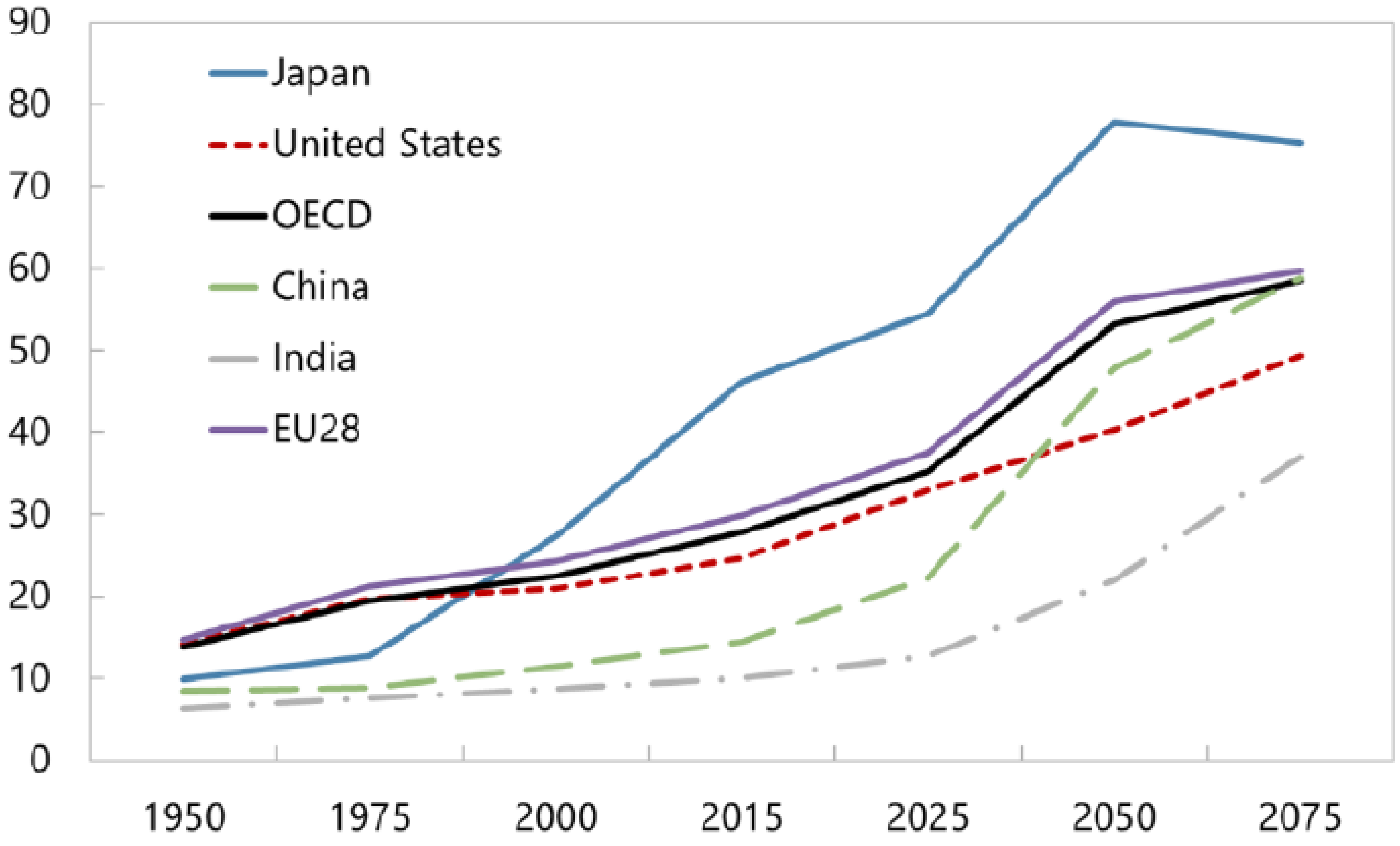
The analysis shows that monetary policy will not solve aging problems. Structural policy will be needed in aging society. The model will show the following policy recommendations. (1) postpone retirement age and ask people to work as long as possible (2) Wage rate must be based on productivity rather than following to seniority based wage rate. These two recommendations will increase labor force and reduce the burden of social security expanses (Yoshino and Miyamoto (2017, 2020)). If these policies are taken, budget deficits will decline and fiscal sustainability could be achieved even if the economy will face with aging population. The dynamic stochastic general equilibrium model will show that these two recommendations were adopted, the growth rate of the economy will be recovered and the budget deficits will be reduced. Postpone of retirement age together with productivity-based wage rate will encourage technological progress for elderly workers so that they can maintain their productivity in both manufacturing and services industries which will push aggregate supply curve to shift to the right. Robots can assist in many sectors so that elderly workers can keep their employment which will reduce budget deficits and lower tax burdens of younger generation.

Figure 1: Old-Age Dependency Ratios (%)

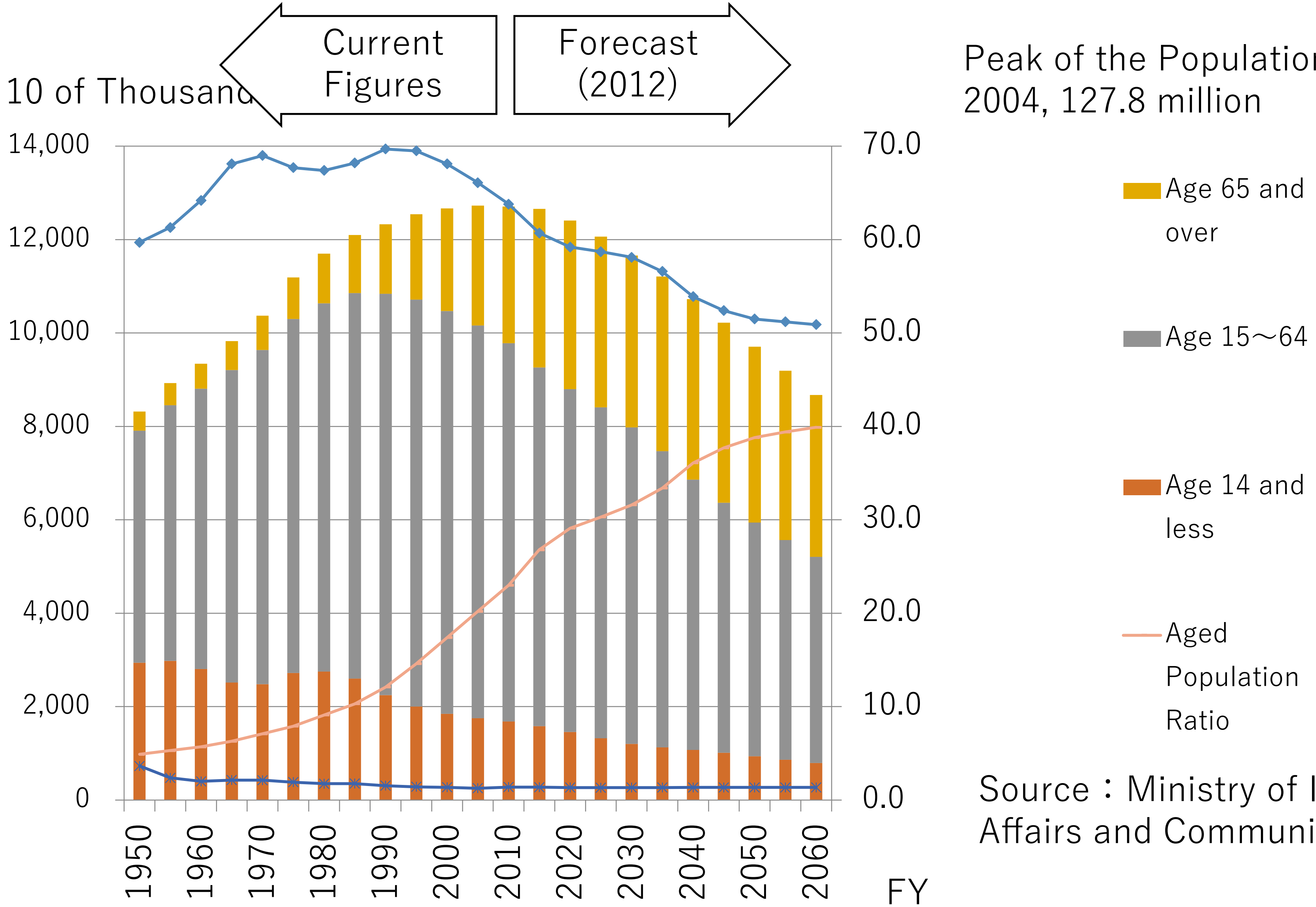
Source:
Yoshino and Miyamoto

"Population Aging: Need For Structural Reform Of the Japanese Employment System"

Japan Spotlight
Sept./Oct. issue, 2020.
PP. 52-54.



Population Aging of Japan

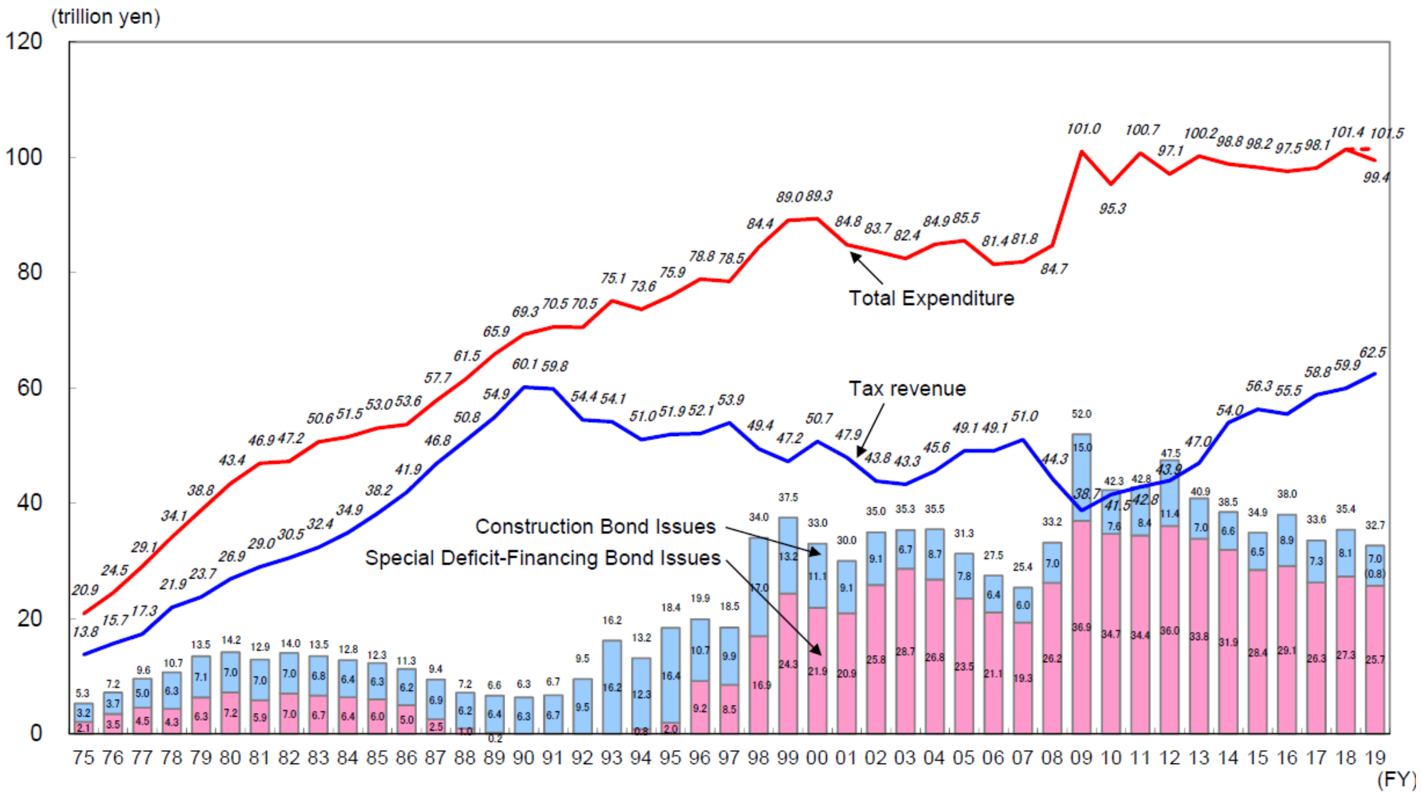


Peak of the Population
2004, 127.8 million

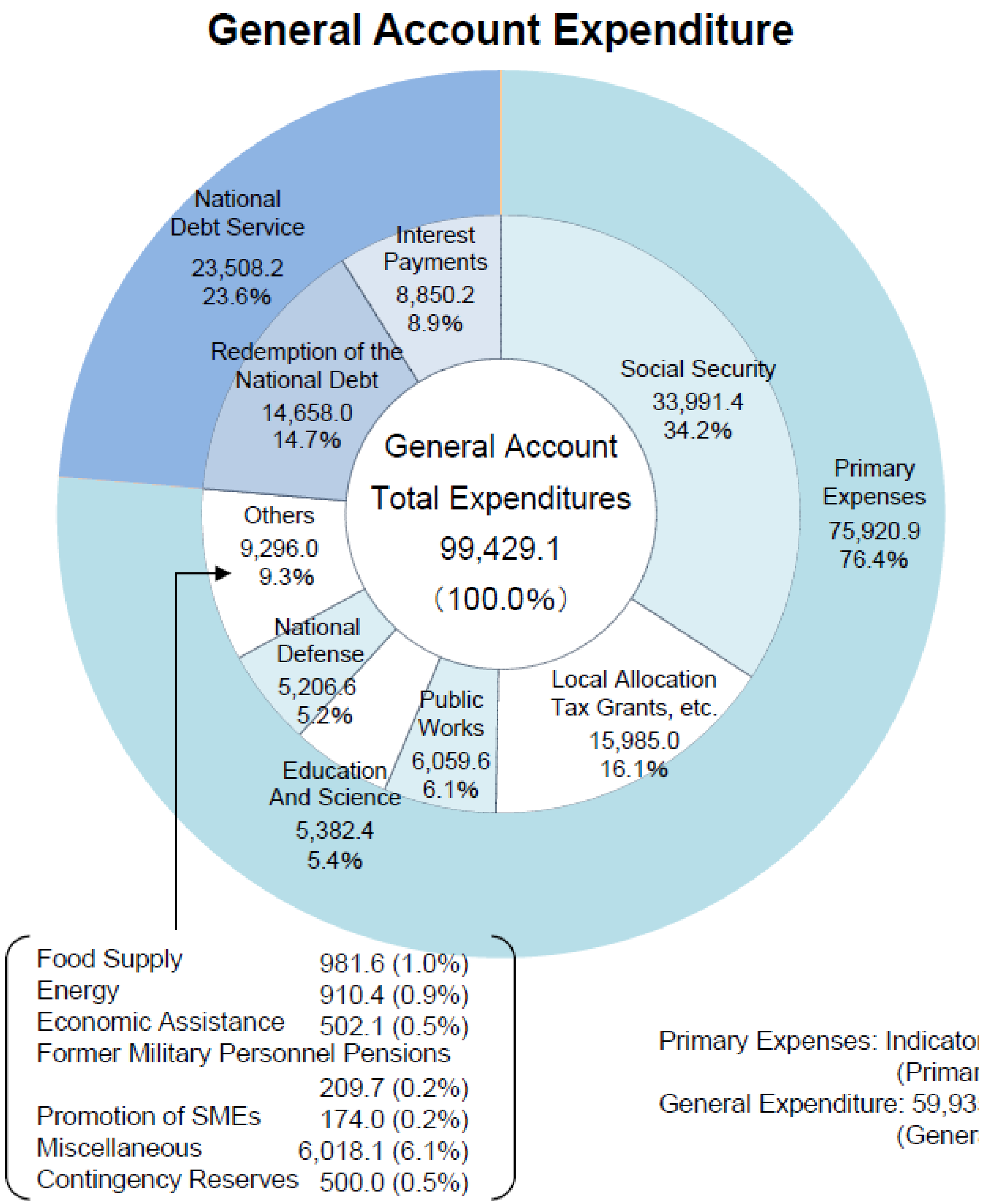
Source：Ministry of Internal Affairs and Communication

Budget deficit has been expanded…

…due to a huge increase of social security due to population aging



Source: Ministry of Finance of Japan



Primary Expenses: Indicato
(Primar
General Expenditure: 59,93
(Gener

Household's problem

- Worker's problem:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} \left[\left\{ \omega c_{w,t}^{\frac{\zeta-1}{\zeta}} + (1-\omega)\, g_t^{\frac{\zeta-1}{\zeta}} \right\}^{\frac{\zeta}{\zeta-1}} \right]^{1-\sigma} + \frac{m_{w,t}^{1-\gamma}}{1-\gamma} - \frac{h_{w,t}^{1+\mu}}{1+\mu} \right\}$$

$$\begin{aligned} \text{s.t. } c_{w,t} + k_{w,t} + m_{w,t} + b_{w,t} \quad &= \quad w_t h_{w,t} + r_{k,t} k_{w,t-1} + (1-\delta) k_{w,t-1} \\ &\quad + R_{t-1} \frac{b_{w,t-1}}{\pi_t} + \frac{m_{w,t-1}}{\pi_t} + d_{w,t} - \tau_{w,t} \end{aligned}$$

Source: Yoshino and Miyamoto (2017) "Declined effectiveness of fiscal and monetary policies faced with aging population in Japan" **Japan and the World Economy,** Vol.42, PP.32-44.

The remaining measure of $1-\phi$ consumers is retired. The lifetime utility function of a retiree is given by

Retirees

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma}\left[\left\{\omega c_{r,t}^{\frac{\zeta-1}{\zeta}} + (1-\omega) g_t^{\frac{\zeta-1}{\zeta}}\right\}^{\frac{\zeta}{\zeta-1}}\right]^{1-\sigma}, \tag{4}$$

where $c_{r,t}$ is a retiree's consumption.

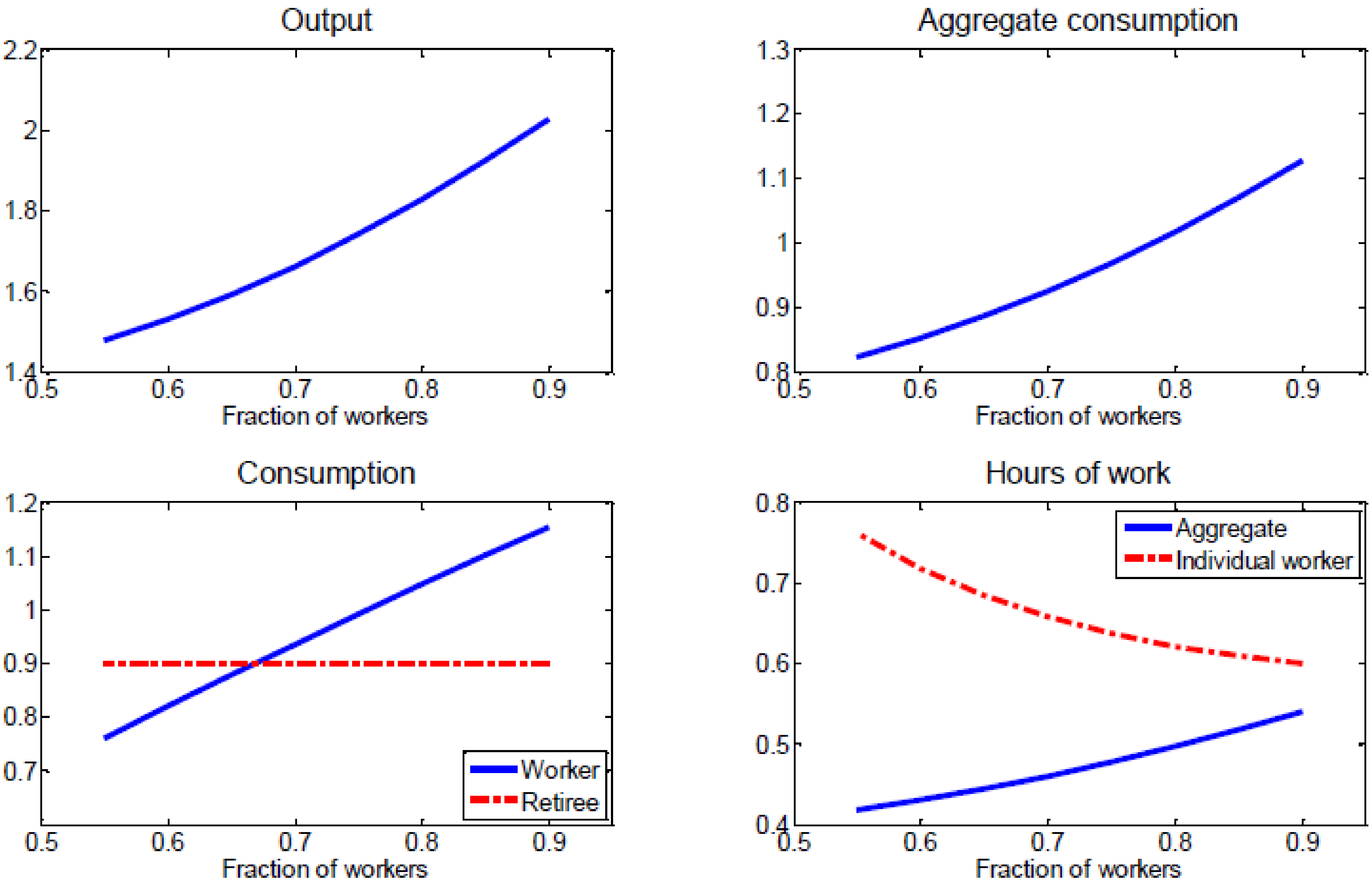
$$c_{r,t} = s + R_t \overline{W_r},$$

where s is the social security benefit in the real term and $\overline{W_r}$ is wealth of the retiree.

Aggregate Consumption

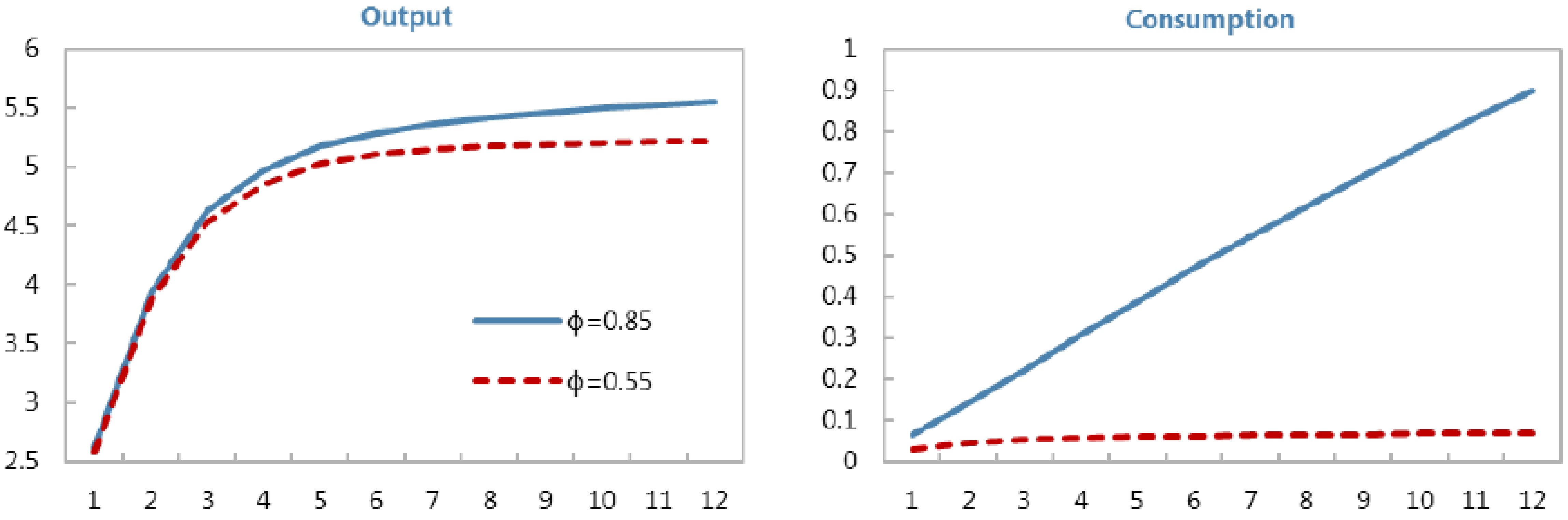
aggregate consumption c_t is given by

$$c_t = \phi c_{w,t} + (1-\phi) c_{r,t}.$$



Source: Yoshino and Miyamoto (2017) “Declined effectiveness of fiscal and monetary policies faced with aging population in Japan” **Japan and the World Economy,** Vol.42, PP.32-44.

Figure 2: The Effects of an Expansionary Monetary Shock



Effects of Expansional Monetary Policy

Monetary Policy (Working Population)

→ Increase investment

→ Wages of working population will rise

→ Consumption of working population will rise

(Retired Population)

→ relies on pensions and social welfare

→ monetary policy does not affect to retirees

Effects of Fiscal Policy (Public Works)

Fiscal Policy (Working Population)

→ Create new jobs

→ Unemployment rate declines

→ Consumption of working population will rise

Retired population

→ Not affected by fiscal policy (punli

→ consumption remains the same

→ lower interest rate reduces their interest income

Empirics – Miyamoto and Yoshino (2020)

- **Specification 1** $$y_{i,t+k} - y_{i,t} = \alpha_i^k + \gamma_t^k + \beta^k shock_{i,t} + \varepsilon_{i,t}^k$$
  - y : log of output (debt-to-GDP ratio, private-investment-output ratio)
  - $shock$: an unanticipated public investment shock
  - α : country fixed effects
  - γ : time fixed effects

- **Specification 2**

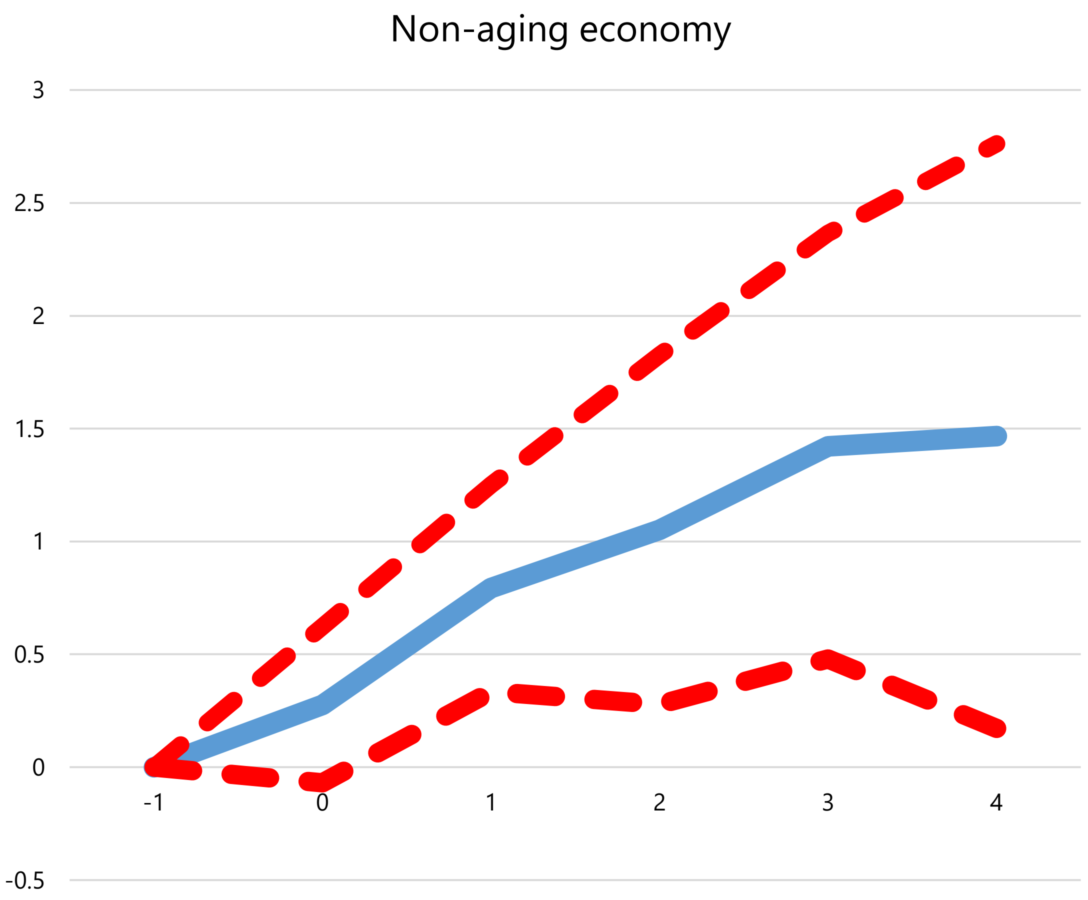
$$y_{i,t+k} - y_{i,t} = \alpha_i^k + \gamma_t^k + \beta_1^k G(z_{i,t}) shock_{i,t} + \beta_2^k \left(1 - G(z_{i,t})\right) shock_{i,}$$

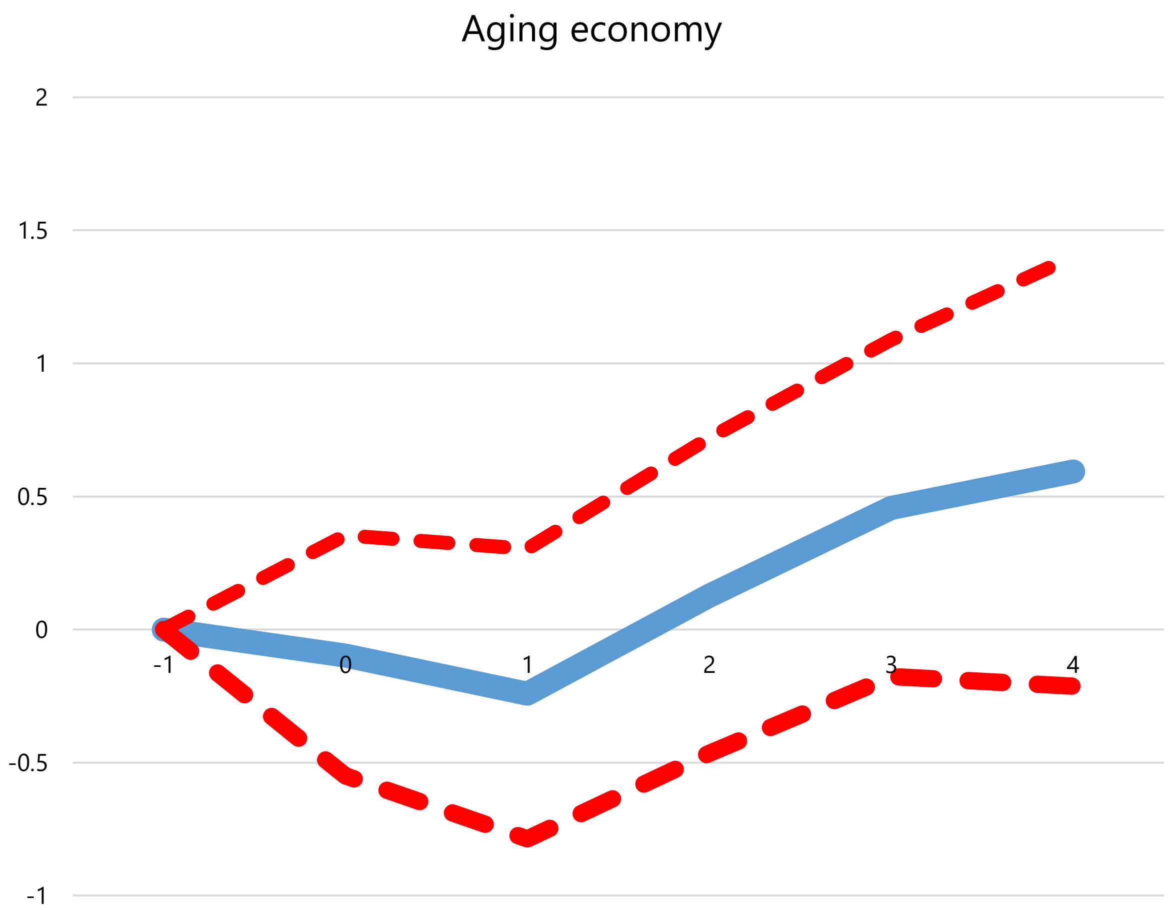
with

$$G(z_{i,t}) = \frac{\exp(-\delta z_{it})}{1 + \exp(-\delta z_{it})}, \delta > 0$$

where δ is an indicator of public investment efficiency

Impact of Fiscal Policy Declines as Population ages





Source: Yoshino and Miyamoto, "Population Aging: Need For Structural Reform Of the Japanese Employment System" ***Japan Spotlight,*** Sept./Oct. issue, 2020. PP. 52-54.

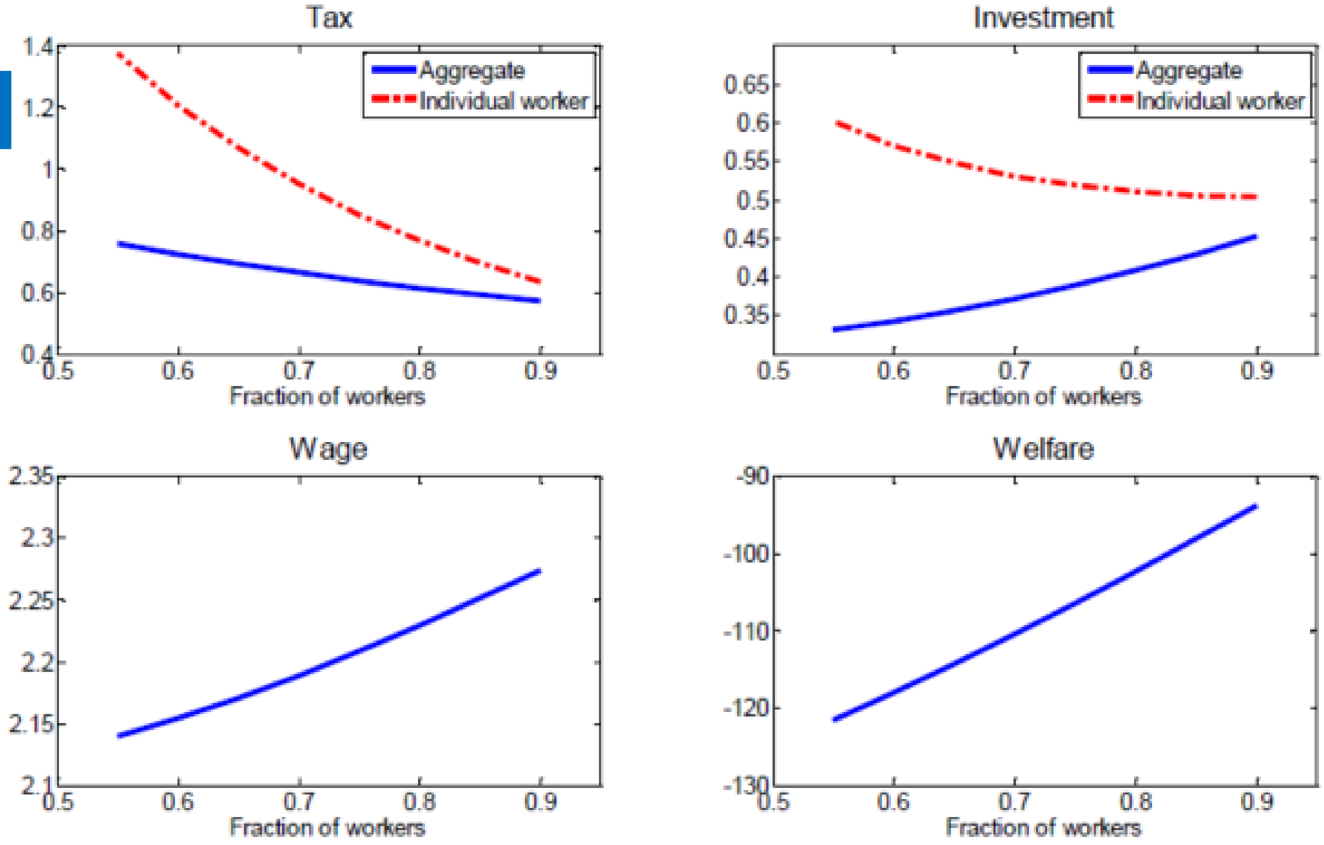
Recommended Policy: Productivity based wage rate and postpone retirement age

Yoshino-Miyamoto (2017) Japan and the World Economy

Yoshino-Farhad-Miyamoto (2017) Credit and Capital Markets

Self Preparation:

Increase of Private Savings



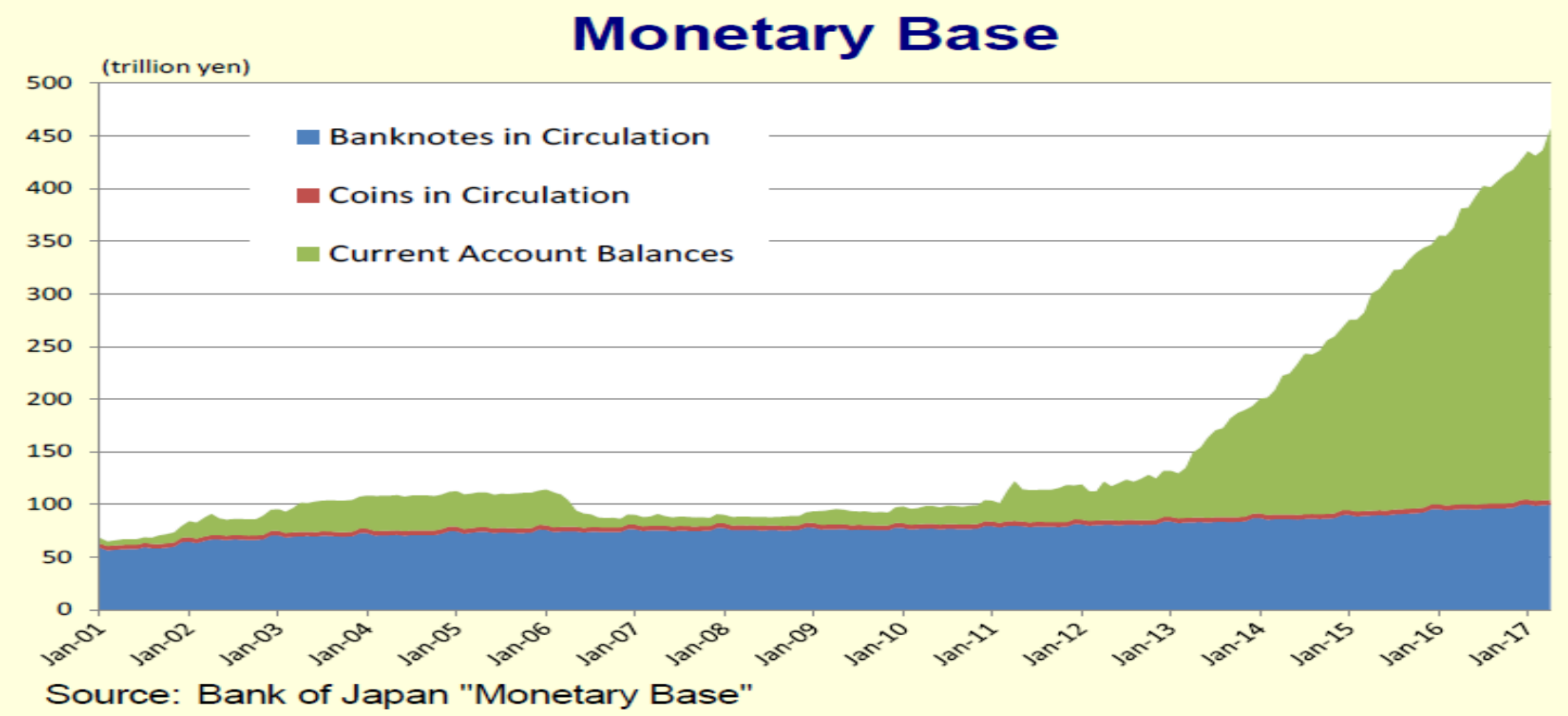
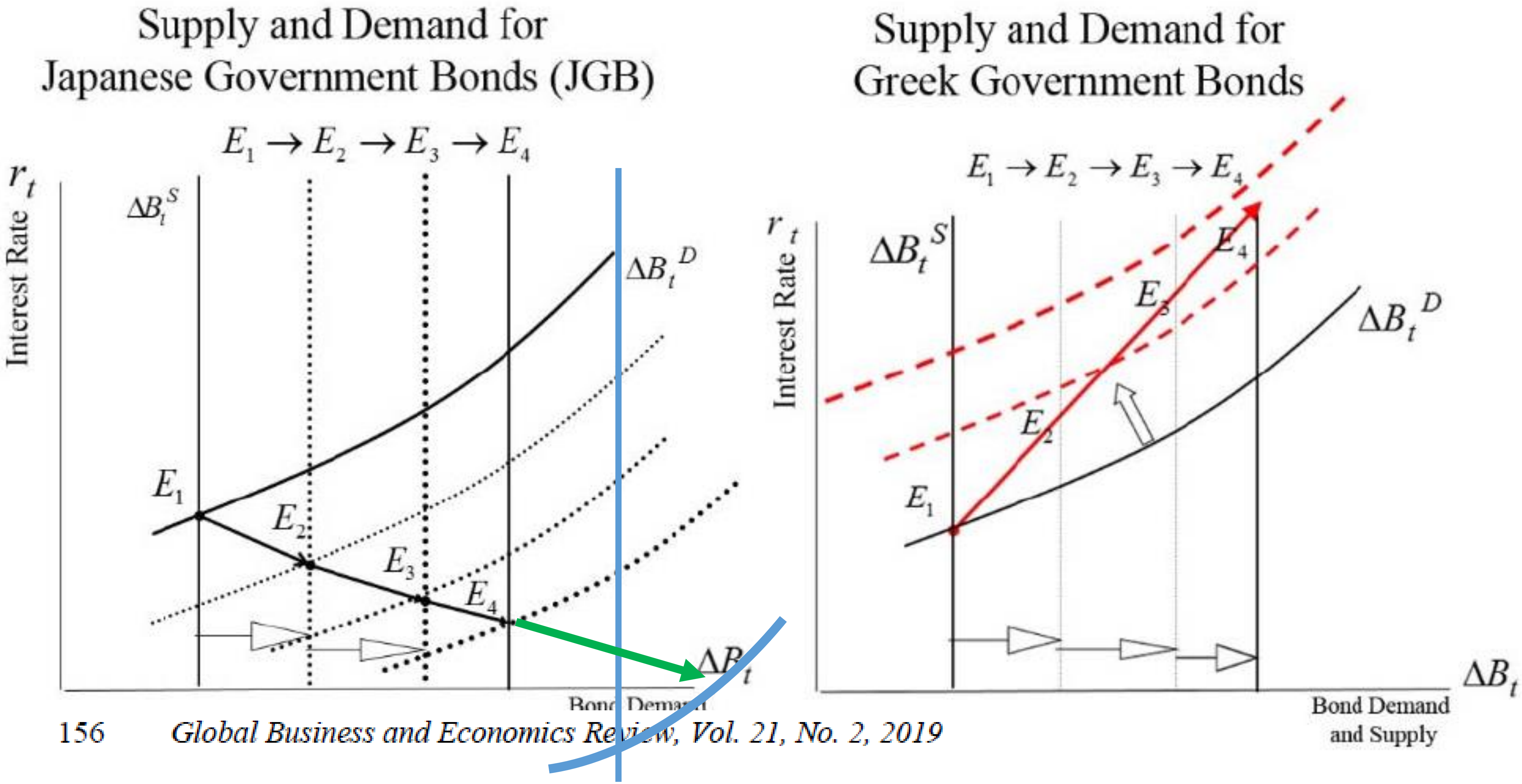

Monetary Base
(trillion yen)
500
450
400
350
300
250
200
150
100
50
0
Banknotes in Circulation
Coins in Circulation
Current Account Balances
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Source: Bank of Japan "Monetary Base"

Figure 1 Government bond markets of Japan and Greece (see online version for colours)



Optimal fiscal policy rule for achieving fiscal sustainability: *the Japanese case* Yoshino-Mizoguchi-Hesary (2019)

Table 1 Holders of Japanese and Greek Government bonds

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		

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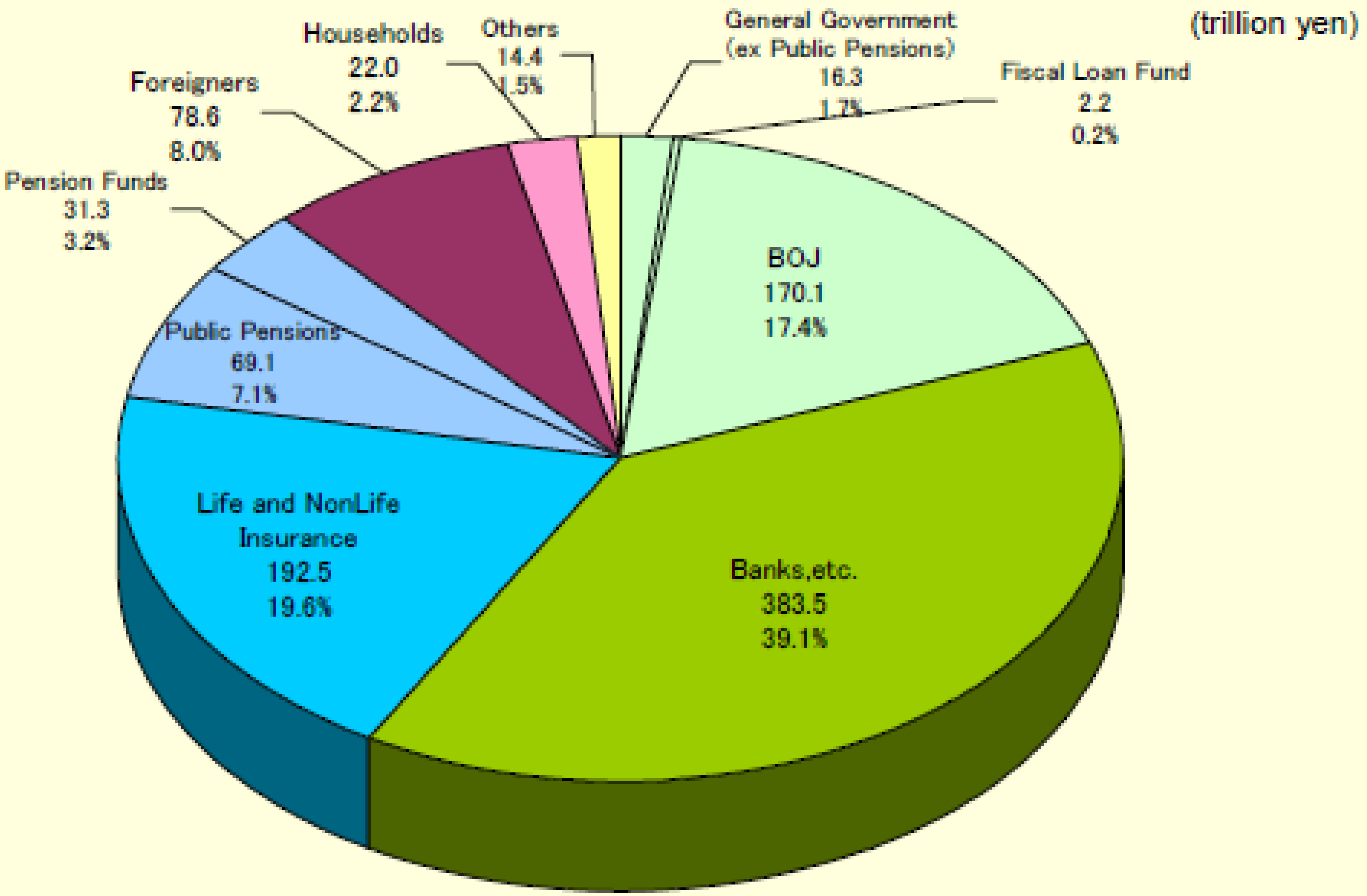
Optimal fiscal policy rule for achieving fiscal sustainability: *the Japanese case*

Yoshino-Mizoguchi-Hesary (2019)

10-Year Government Bonds Yields

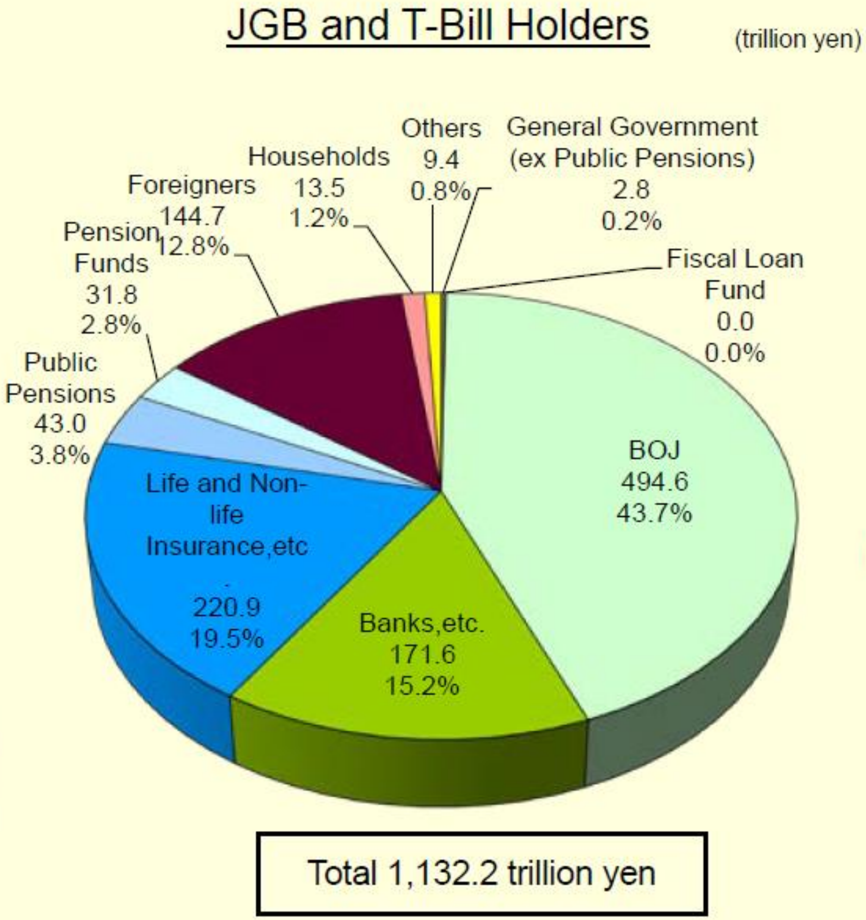
(Source) Bloomberg

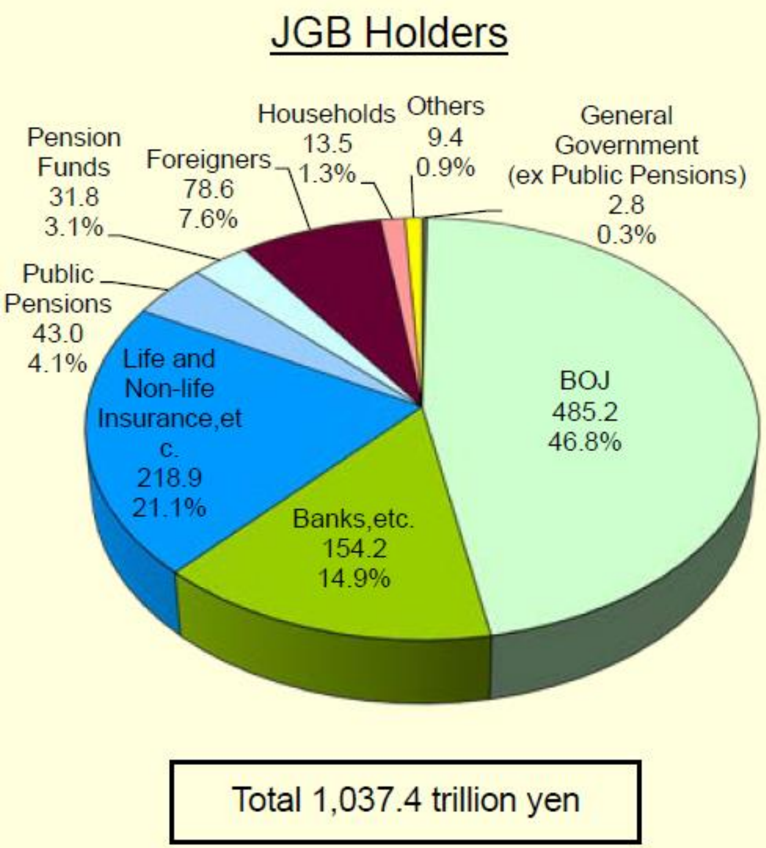
Breakdown by JGB Holders (Sep. 2013,QE)

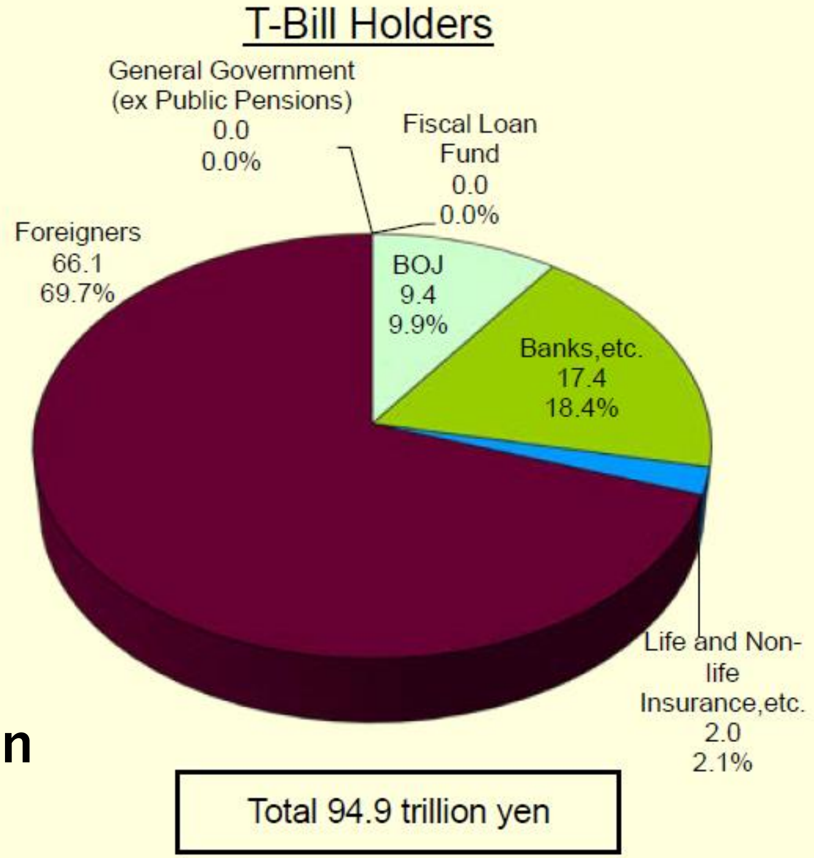


Note1 : "JGB" includes FILP Bonds and T-Bills.
Note2 : "Banks, etc" includes Japan Post Bank, "Securities investment trust" and "Securities Companies"
Note3 : "Life and Nonlife insurance" includes Japan Post Insurance.
Source: Bank of Japan

Breakdown by JGB and T-Bill Holders (The end of Dec. 2019 QE)





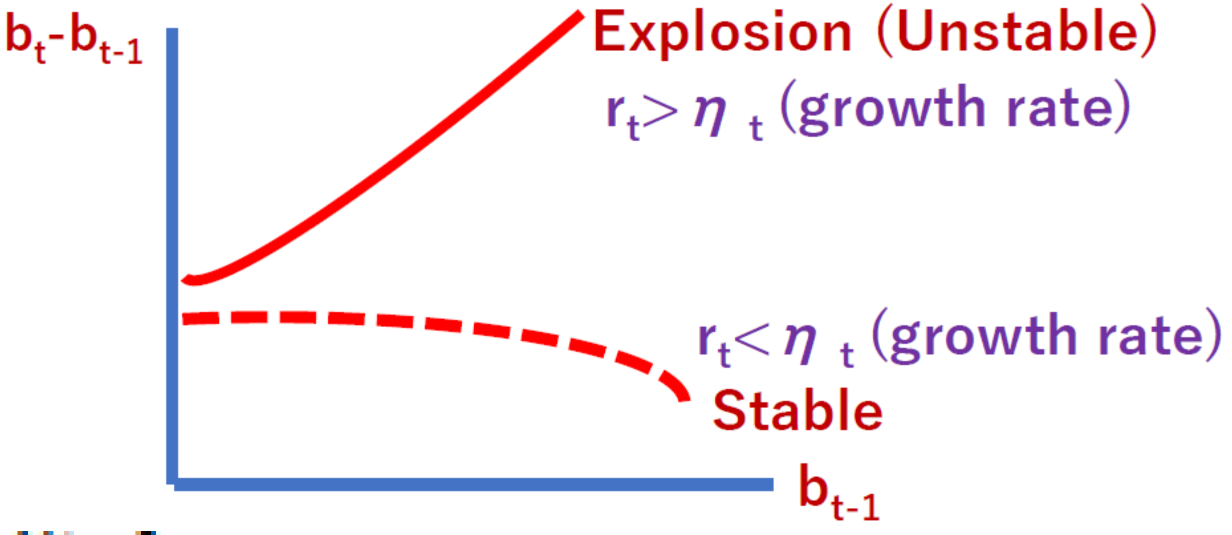


Source: Ministry of Finance, Japan

Domar Condition of Fiscal Stability

The Domar condition is often used to judge whether the budget deficit is sustainable. The Domar condition is obtained from the government budget constraint:

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



where G_{t} is government spending, B_{t} is tl

revenues, and r_{t} is the interest rate for publi

can obtain

$$b_t - b_{t-1} = g_t - t_t + \frac{r_t - \eta_t}{1 + \eta_t} b_{t-1},$$

Interest Rate (r_t) > growth rate of the economy(η) → Unstable

Interest Rate (r_t)< growth rate of the economy(η) → Stable

Source: forthcoming, *Global Solutions Journal*, December 2020

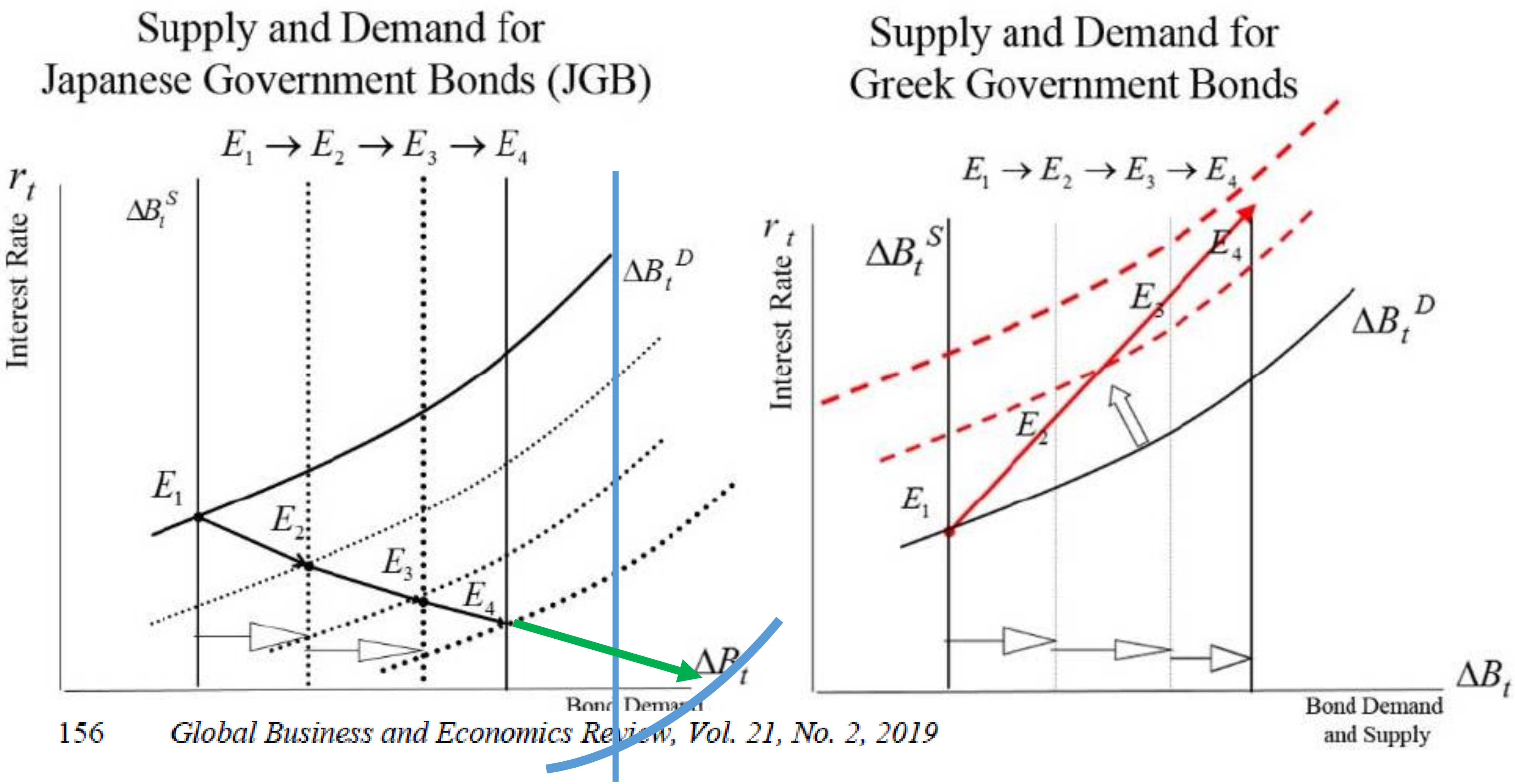
Revival of Domar Condition by Paul Krugman and Tirore

1. **Domar, E.D. (1944), "The Burden of Debt and the National Income", American Economic Review, 34(4), pp. 798-827.**
2. **Krugman, P. (2020), "The case for permanent stimulus", Mitigating the COVID Economic Crisis: Act Fast and Do Whatever It Takes, Edited by Richard Baldwinand Beatrice Weder di Mauro, A CEPR Press VoxEU.org eBook.**

Domar condition is obtained only by the supply side of government bonds and does not take into account of demand for government bonds.

US government bonds are purchased by all over the world.

Figure 1 Government bond markets of Japan and Greece (see online version for colours)



Optimal fiscal policy rule for achieving fiscal sustainability: *the Japanese case*

Yoshino-Mizoguchi-Hesary (2019)

Revised Domar Condition

$$\Delta B_t^d = b_0 + b_1\left(\sigma_t^B, \sigma_t^I\right)\left(r_t^B - r_t^I\right).$$

$$\Delta B_t = G_t + r_t^{B*} B_{t-1} - \overline{T}_t - \Delta M_t. \tag{9}$$

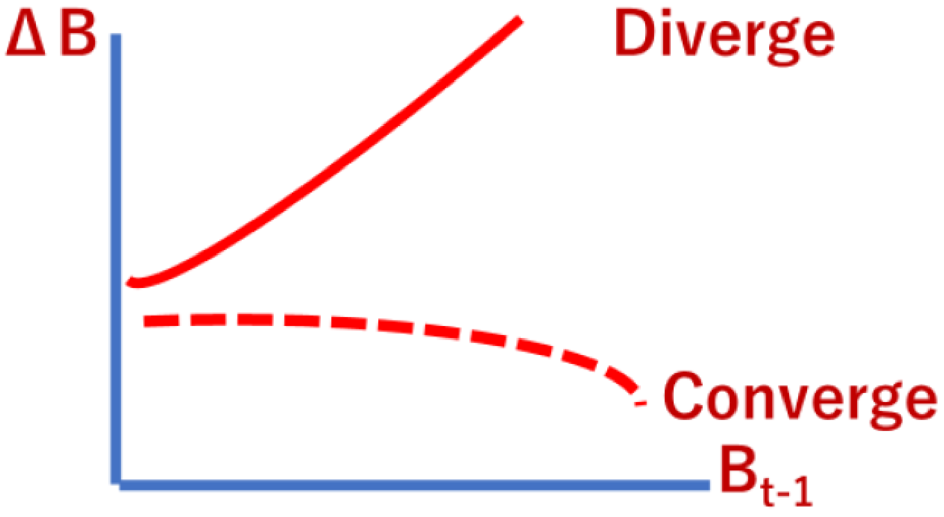
$$\frac{\partial \Delta B_t}{\partial B_{t-1}} = \frac{\partial r_t^{B*}}{\partial B_{t-1}} B_{t-1} + r_t^{B*}, \tag{10}$$

$$\frac{\partial r_t^{B*}}{\partial B_{t-1}} = \frac{G_t - \overline{T}_t - \Delta M_t - b_0 + b_1\left(\sigma_t^B, \sigma_t^I\right) r_t^I}{\left[b_1\left(\sigma_t^B, \sigma_t^I\right) - B_{t-1}\right]^2} = \frac{r_t^{B*}}{b_1\left(\sigma_t^B, \sigma_t^I\right) - B_{t-1}}.$$

Then, (10) can be rewritten as

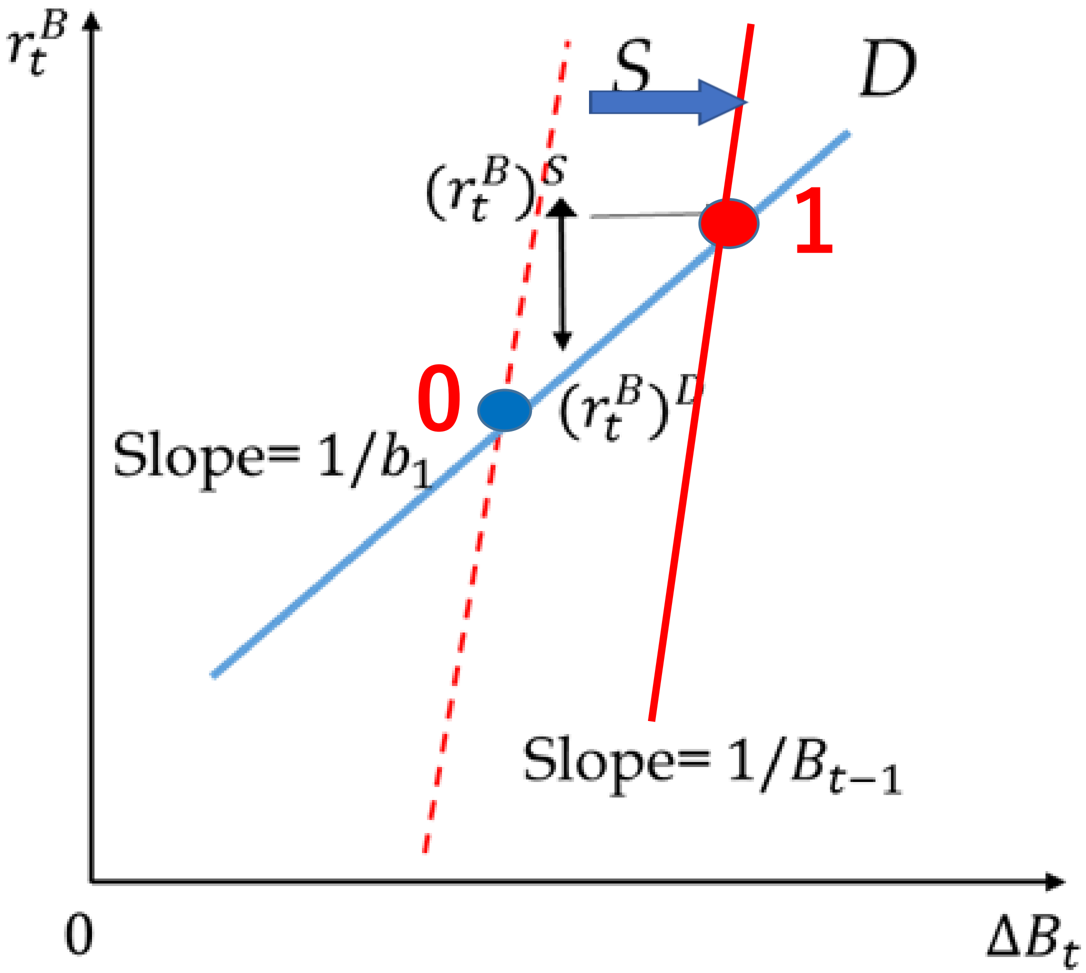
$$\frac{\partial \Delta B_t}{\partial B_{t-1}} = \left(\frac{1}{1 - \frac{B_{t-1}}{b_1\left(\sigma_t^B, \sigma_t^I\right)}}\right) r_t^{B*}.$$

$$\frac{\partial \Delta B_t}{\partial B_{t-1}} \gtreqless 0 \Leftrightarrow 1 \gtreqless \frac{B_{t-1}}{b_1}.$$

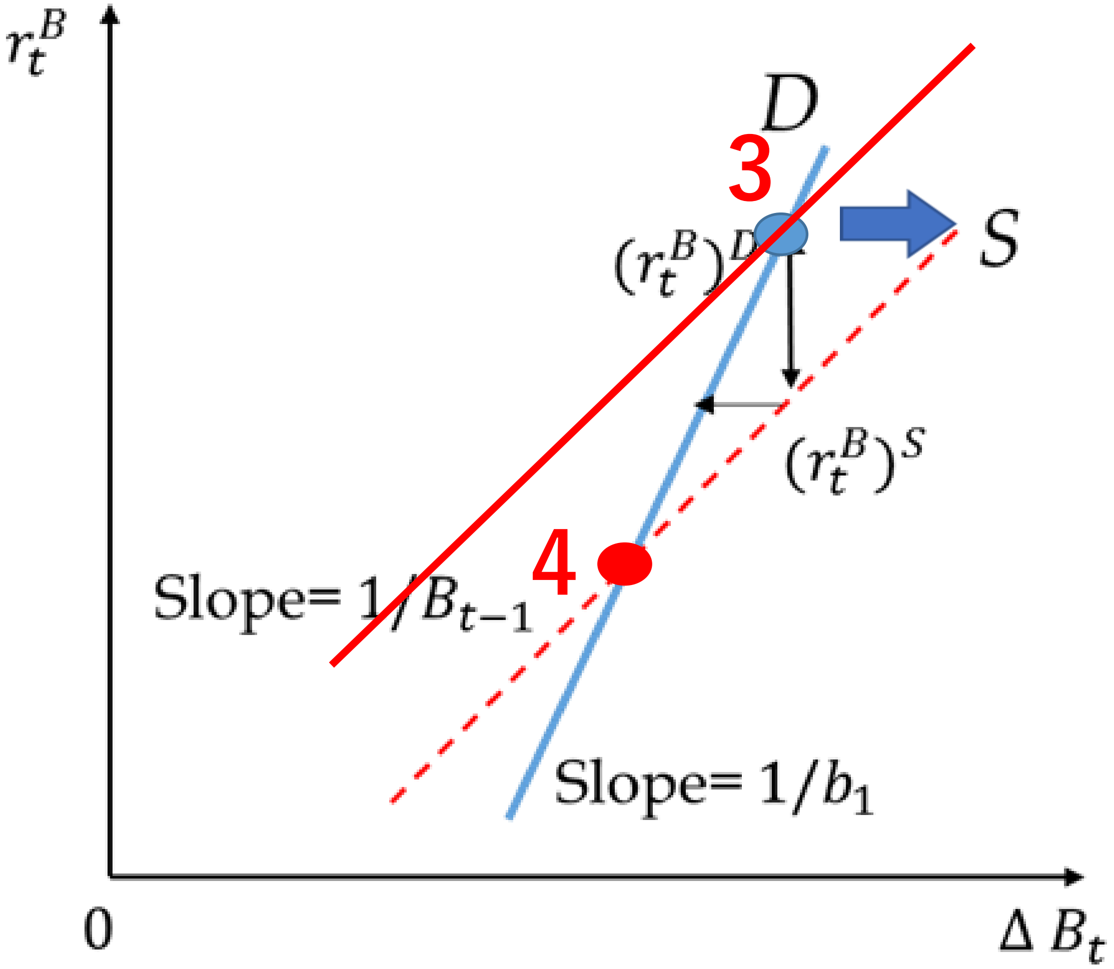


Revised Fiscal Stability Condition

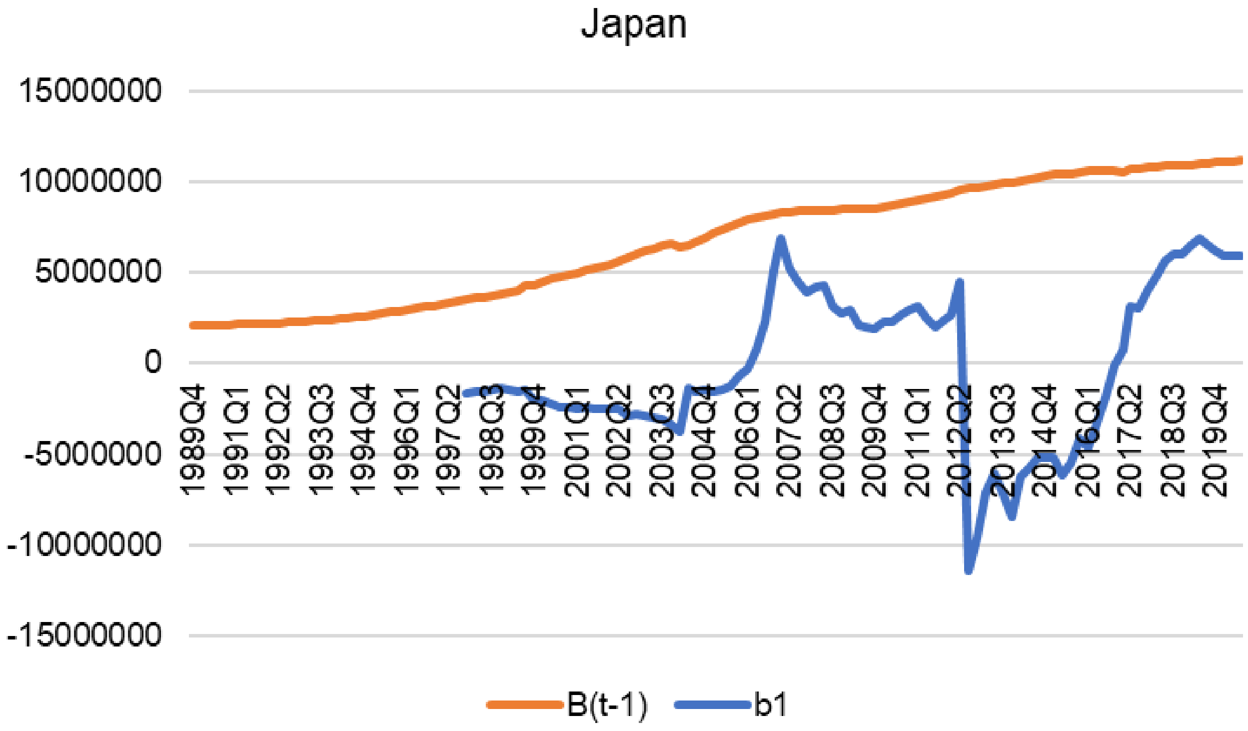
Explosion case ($B_{t-1} < b_1$)

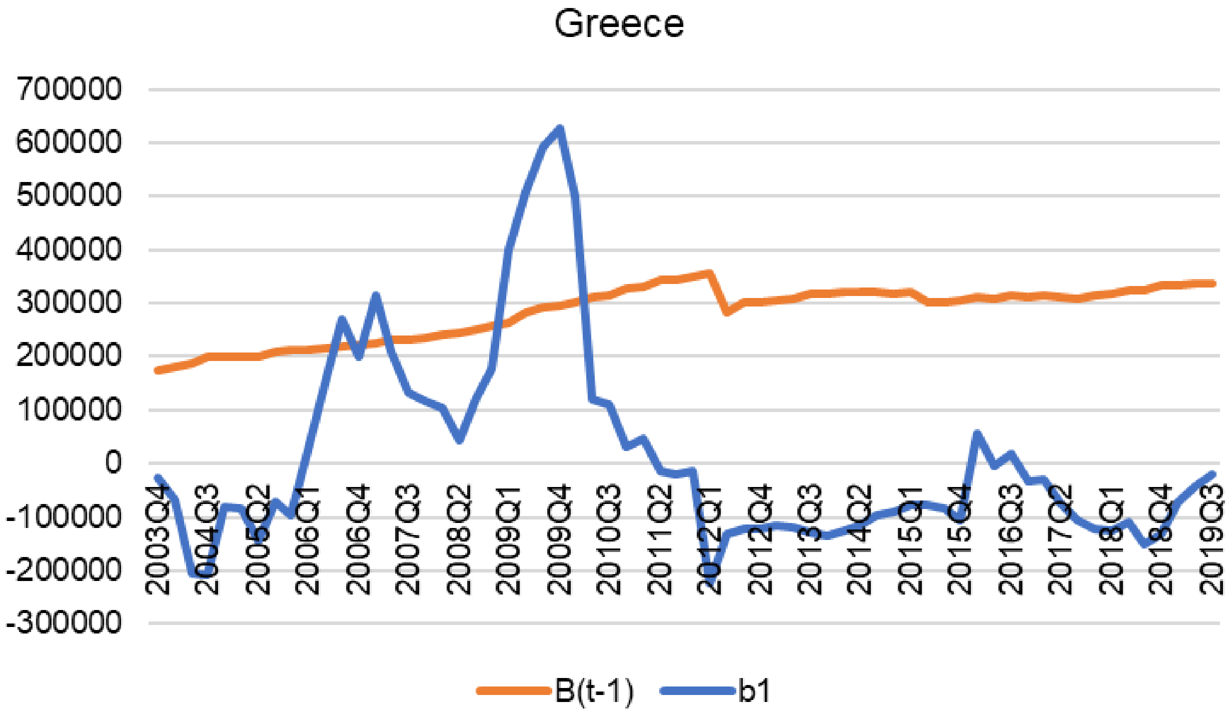


Stable case ($B_{t-1} > b_1$)



Comparison between Greece and Japan





ADBI Discussion paper (2020)

Revisit Public Debt Stability Condition: Rethinking of the Domar Condition

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Hiroaki Miyamoto, Tokyo Metropolitan University

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