Government's Projection and Public Debt Sustainability※

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Abstract

This paper reconsiders the Japan's fiscal sustainability. We investigate if the simulation conducted under the political constraint imposed by the fiscal reaction function supports the official projection. First, we obtain the Japan's fiscal reaction function by estimating the response of the primary surpluses to the past debt for a panel data set of 23 OECD countries. Next, we investigate the politically feasibility of the official projection using our estimated reaction function. The fast-growth case realizes the policy target of non-negative primary surpluses, while the baseline case cannot. The contrasting results arise from the difference in the projected growth-adjusted interest rate as well as the projected growth rate.

Keywords: Government Debt, Sustainability, Official Projection

JEL H63(Sovereign Debt), H68(Forecasts of Deficits and Debt)

※ The views and opinions expressed here are those of the authors and do not represent those of ESRI.

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Contents

1.Introduction

Stimulating fiscal spending after the global financial crisis led to the higher ratios of the outstanding public debt to GDP in many advanced countries, but low nominal and real bond yields have sustained the debt. Among them, Japan has the highest outstanding public debt to GDP ratio, and is one of countries of great concern.[2]

Nevertheless, the government reaction is slow. The Abe cabinet had launched the schedule of attaining non-negative primary surpluses in 2020, but recently postponed the time limit from 2020 to 2025.

Twice every year, the cabinet office releases the outlook of fiscal balances along with the GDP growth rate that is projected to be consistent with the fiscal target of attaining non-negative primary surpluses.[3] Our concern is whether this projection is politically feasible. The policy delay is an observation of "fiscal fatigues" that arises when democratic voters object to ever increasing primary surpluses in response to rising debt. Ever since Bohn (1998), the literature has addressed this political constraint by

[2] The huge literature investigates the fiscal sustainability in Japan. It includes Doi and Ihori (2003), Broda and Weinstein (2005), Ihori *et al.* (2006), Sakuragawa and Hosono (2010, 2011), Doi, Hoshi, and Okimoto (2011), Hoshi and Ito (2013), Matsuoka (2015), Miyazawa and Yamada (2015), Braun and Joines (2015), Hansen and Imrohoroglu (2016), Nakajima and Takahashi (2017), and others.

[3] See https://www5.cao.go.jp/keizai2/keizai-syakai/shisan.html.

considering the fiscal reaction function that links primary balances to the debt.[4] The official projection does not appear to take into account this political constraint. The aim of this paper is to investigate if the simulation conducted under the political constraint imposed by the fiscal reaction function supports the official projection.

We proceed with the analysis in the following steps. First, we obtain the Japan's fiscal reaction function by estimating the response of the primary surpluses to the past debt for a panel data set of 23 OECD countries.[5] Secondly, we investigate the politically feasibility of the official projection using our estimated reaction function.

The approach of using the fiscal reaction function have two advantages. This approach deals with fiscal default as a problem of the inability to pay rather than strategic default found in developing countries (e.g., Calvo 1988, Arellano 2008, and others), and is more likely to be relevant for studying public debt in advanced countries, such as Japan. Secondly, this approach is useful to study an economy of low interest rates, particularly when the interest rate is less than the economic growth rate.

A huge literature provides quantitative analysis of fiscal sustainability in Japan. Closely related are the papers that investigate the effects of low real interest rates on fiscal sustainability. Sakuragawa and Hosono (2010, 2011) build a heterogeneous-agent growth model allowing for the real interest rate smaller than the growth rate, thus explaining a case of fiscal sustainability by the consumption tax rate less than 20 percent. Matsuoka (2015) explains the debt limit of Japan by the low subjective discount rate.

[4] The literature includes Ostry and Abiad (2005), Mendoza and Ostry (2008), Ghosh *et al.* (2013), and others.

[5] Several papers attempted to estimate the fiscal reaction function using the Japanese data but were short of obtaining successful estimates.

2. Government Outlook and Low real interest rate

The budget constraint of the government is written as

$$s_{t+1} = \frac{1+R_{t+1}}{1+g_{t+1}} d_t - d_{t+1}, \tag{1}$$

where s_t denote the primary surplus as a proportion of GDP, d_t denote the debt as proportion of GDP, g_{t+1} is the GDP growth rate, and R_{t+1} denote the net yield on the government bonds.

The current debt has to be financed by the future primary surpluses from the neoclassical view that is grounded on the premise that the real interest rate is higher than the economic growth rate.

The government's stance differs a bit from this neoclassical view. The Abe cabinet had launched the schedule of attaining non-negative primary surpluses in 2020, but recently postponed the time limit from 2020 to 2025. Equation (1) shows that $s_{t+1} = 0$ is realized only if $R_{t+1} = g_{t+1}$, given that the government keeps d_t constant over time.[6] This discussion is reminiscent of the famous Domar condition, stating that if the interest rate is less than the growth rate, the government can sustain the debt buy rolling over the one-period bonds under the primary balance.

The fiscal stance against the neoclassical view is not necessarily strange from the recent observed fact. Figure 1 illustrates the nominal GDP growth rate and 10 years bond yield in Japan (sources: Cabinet Office and Ministry of Finance). Until 2012, the interest rate has been higher than the growth rate, but since around 2013 when QE started, the interest rate approaches zero, but the growth rate is over 2 percent. Now the Japanese economy is under a region of the negative growth-adjusted interest rate.

[6] Along with the official projection that the debt to GDP ratio increases at the annual rate of 1.1 percent during 2016-2025, announcing the fiscal target of non-negative primary surpluses reveals that the government bond yield is higher than the GDP growth rate by 1.1 percent.

Furthermore, we find the global trend on the low interest rate, particularly the one relative to the GDP growth rate. Figure 2 illustrates the nominal GDP growth rate and long-term bond yield averaged over 23 OECD countries (source, OECD). The long-term bond yield is intended as the proxy of the risk-free interest rate so that we exclude data of four European countries that had fiscal troubles in the Eurozone fiscal crises during 2010-2012. Over the past three decades, the long-run interest rate has declined more sharply than the economic growth rate. Since 2000 around, the tendency for the higher interest rate is not found, but rather the recent decade after the global financial crisis, the growth rate tends to be higher than the interest rate. There is a background of the view that the low nominal and real bond yields have sustained the debt.

3. Estimating Fiscal Reaction Function

Ever since Bohn (1998), the approach of using the government's reaction function is popular in the literature. The response of the primary surplus to the debt is in general supposed to be increasing. Rational voters will agree to the rise in tax or the reduction in the expenditure when the debt rises. However, the positive correlation may disappear either at very low levels of debt or at very high levels of debt, or both. At very low levels of debt, citizens will be indifferent to the fiscal problem so that the negative relationship may emerge statistically. At very high levels of debt, governments in advanced countries are subject to political constraints that democratic voters object to ever increasing primary surpluses in response to rising debt. Ghosh *et al*. (2013) identify the negative relationship at very high levels of debt as the "fiscal fatigue".

The government is committed to follow a fiscal reaction function;

(2) $$s_{t+1} = \mu + f(d_t)\,.$$

The function $f(.)$ is continuously differentiable, and either increasing or decreasing in d_t. It represents the response of the primary surplus to the debt, depending on the past debt as a proportion of GDP. The parameter μ captures systematic determinants of the primary balance other than the past debt.

We obtain the debt dynamics from (1) and (2) by

(3) $$\mu + f(d_t) = \left(\frac{1+R_{t+1}}{1+g_{t+1}} - 1\right) d_t - \Delta d_{t+1},$$

where $\Delta d_{t+1} \equiv d_{t+1} - d_t$. To consider the possibility of fiscal default, the function has the property that there exists a debt d^m such that, for any $d_t > d^m$,

(A) $$\mu + f(d^m) < \frac{1+R}{1+g} d^m - d^m \text{ and } f'(d^m) < \frac{1+R}{1+g} - 1$$

given R_{t+1}. At $d_t = d^m$, the primary surplus cannot cover the interest payment, and once the economy falls into this fiscal trouble, the response of primary balance is so weak that the government cannot escape from this situation.

Figure 3 plots the debt dynamics when Condition (A) holds. The graph is illustrated to have two intersections. Around the lower intersection $\tilde{d}$, the reaction of the primary surplus to the debt is strong enough, such that the debt converges to $\tilde{d}$. The condition for the stable debt-GDP ratio dynamics is that the marginal response of the primary balance to the debt should be larger than the growth-adjusted bond yield. However, even the positive response of the primary surplus to the debt does not rule out an ever-increasing debt-to-GDP ratio. There is also the higher intersection $\bar{d}$. If $d_t < \bar{d}$, the primary surplus always cover the interest payment so that the government can reduce the debt toward $\tilde{d}$, but if $d_t > \bar{d}$, the primary surplus cannot cover the interest payment anymore so that the debt should explode indefinitely. The debt $\bar{d}$ is the debt

limit in the deterministic case, in which the default probability is zero up to the debt limit, jumping to unity thereafter.

We are now ready to estimate a fiscal reaction function that is non-linear in terms of the debt level using a data of 23 advanced countries over the period 1985-2014. [7] We conduct estimations for a cross-country panel data that varies across countries (indexed by i) and over time (indexed by t), along with country-specific fixed effects.

The estimation equation is written in the cubic form as

$$(4) \qquad s_{it} = c_i + a_1 d_{it-1} + a_2 d_{it-1}^2 + a_3 d_{it-1}^3 + a_4 X_{it} + u_{it},$$

where s_{it}, d_{it}, c_i, X_{it}, u_{it} represent the primary surplus to GDP ratio, the debt to GDP ratio, the country-specific fixed effect, a vector of control variables, the error term, respectively. We allow for the serial correlation in the error term and model as an AR(1) process, with $u_{it} = \rho u_{it-1} + \omega_{it}$, $|\rho| < 1$ and $\omega_{it} \sim$ IID $(0, \sigma_\omega^2)$.[8]

We pick up a number of variables that are likely to affect a country's primary surplus apart from debt. The GDP gap controls for the effect of business cycles, and its coefficient is expected to be positive. The government expenditure gap captures the effect of temporary fluctuations in government outlays, and its coefficient is expected to be negative. The inflation rate is expected to influence the fiscal balance through the bracket-creep effects, and its coefficient is expected to be positive. The trend GDP growth rate captures the effect of the automatic increase in tax revenues, and its coefficient is expected to be positive. The ratio of current account to GDP is expected to have a positive effect on the fiscal surplus. The government of a country with the

[7] The literature reports the non-linear response of fiscal behavior. See Bohn(1998), Ostry and Abiad (2005) , Mendoza and Ostry (2008), Ghosh *et al.* (2013), and others.

[8] We allow for the possibility that an unobserved shock of the current period will affect the fiscal reaction by the government at least for next several periods. When we estimate the equation by ignoring the serial correlation of disturbances across periods, the estimates are consistent but inefficient estimates of the regression coefficients and biased standard errors.

current account surplus can secure more tax revenue. For example, an oil exporting country has the large current account surplus if oil price rises. Data source and data description are shown in Appendix 1.

Table 1 presents the estimation results. The estimation 1 controls for two variables only, and the estimation 2 controls for all the six. The estimation 3 takes into account the Eurozone fiscal crisis. The dummy variable takes one for the five troubled countries, Greece, Ireland, Italy, Spain and Portugal and for three years ($t = 2010,2011,2012$), and zero otherwise.

For all the three estimations, the coefficients of the debt, the squared debt, the cubed debt, are statistically significant, and its signs are negative, positive, negative, and positive, suggesting a non-linear relationship between primary surpluses and debt. Looking at the coefficients of the controlling variables, the signs are all as expected, and many of them are statistically significant.

Using the coefficients of estimation 2, we construct the Japan's reaction function. The coefficients of the primary balance to the debt are common to each country, but the constant term differs across countries. The country-specific constant term consists of the sum of the coefficient of the country specific fixed effect and the coefficients of 5 control variables (the output gap, the government expenditure gap, the ratio of the current account to GDP, the trend GDP growth, and the inflation rate) multiplied by the each country's sample average. The constant term of Japan is the smallest among all.

Figure 4 illustrates the estimated reaction function of Japan. The non-linearity is found. At the debt level less than 50 percent of GDP, the primary surplus declines as the debt increases, capturing the indifference or ignorance of citizens to the fiscal problem. As debt increases, the primary surplus rises from debt levels of around 50-60 percent of

GDP but the marginal response eventually begins to weaken and then decreases at high levels of debt. Finally, the primary surplus begins to decline at levels of 190-200 percent of GDP, capturing the fiscal fatigue. The downward region may capture a situation in which the fiscal burden is so heavy that citizens are less farsighted and tend to prefer the populist government.

Figure 5 plots observations on the primary surpluses and debt both as a proportion of GDP over 2011-2020, along with the estimated reaction function. The red data are from Cabinet Office, while the blue data are from IMF. The difference captures the difference in the definition of debt. The debt in the IMF data includes T-bills, but the debt in the Cabinet Office data does not.

For both data, the primary surpluses and the debt increase over time. The reaction function is located upwardly around the Cabinet Office data, but downwardly around the IMF data. The data choice will have different implications on the fiscal sustainability.

4. Calculation

The upper panel of Table 2 lists the official projections at 2025. The government examines the “fast-growth” scenario and the “baseline” scenario. Numbers in the fast growth case are constructed to realize almost the target of positive primary surpluses at 2025, but not in the baseline case. There are differences in the inflation rate, real interest rate as well as the real GDP growth rate. The fast growth scenario includes the high growth rate, the high inflation rate, and low real interest rate, while the baseline scenario includes the modestly high growth rate, the low inflation rate, and high real interest rate. The remarkable difference is the “growth adjusted interest rate” that the

growth-adjusted interest rate. It is very low of -1.3% in the former, while it is zero in the latter.

We examine if the projected numbers are consistent with the fiscal target by using our estimated reaction function. We have to update the estimated reaction function by incorporating the information from 2015. We adjust the constant term by adding the effects of the increases in the consumption tax rate. In 2014 the government increased the consumption tax rate from 5 to 8 percent. According to Ministry of Finance, the tax revenue increased by 6.6 trillion yen. In 2019 the government plans to increase the consumption tax rate from 8 to 10 percent. In addition, the constant term is to be adjusted when the projected real GDP growth rate and inflation rate differ from the figures used in the estimation. The pair of the growth rate and the inflation rate used in the estimation is (1.7%, 0.6%), and differs from the projections.

The fast-growth case realizes the policy target of positive primary surpluses when the consumption tax is increased in 2019 as planned.

Figure 6 illustrates graphic images. The reaction functions are nonlinear. The solid curve corresponds to the case when the consumption tax is increased, and the dotted curve when not increased. The interest payment line is downwardly sloped due to the negative growth adjusted interest rate (the growth adjusted interest rate is the slope).

When the consumption tax is increased in 2019, the reaction function is above the target, and the interest payment line is less than the target, and thus the policy target is attainable. Strictly, the policy target for primary surpluses is attainable if the following two conditions are satisfied. The first condition is that the reaction function is above the interest payment line at the level of debt for the target. The second condition is that the reaction function is above the target. interest payment line at the level of debt for the

target. When the tax change is not implemented, the fast-growth case does not realize the policy target of non-negative primary surpluses. The policy performance depends on the growth-adjusted interest rate. As the growth-adjusted interest rate turns from negative to positive values, the target is less likely to be attained.

Figure 7 illustrates the case for the baseline scenario. The reaction functions shift downwardly due to the decline in the projected growth rate. The interest payment line becomes flat and accords with the horizontal line. The baseline scenario is short of attaining the policy target. The lower panel of Table 2 depicts the calculation results.

5. Conclusion

We investigate if the simulation conducted under the political constraint imposed by the fiscal reaction function supports the official projection. Using the Cabinet Office data, the fast-growth case realizes the policy target of non-negative primary surpluses, whereas the baseline case cannot. The contrasting results arise from the difference in the projected growth-adjusted interest rate as well as the projected growth rate. We have to stress that these results rely on assuming the lower bond yields relative to the GDP growth rate than the neoclassical case.

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Appendix 1: Data description

This appendix explains variable definitions and data sources for estimating fiscal reaction function.

Primary surplus to GDP ratio

We use the general government primary net lending/borrowing as shares of GDP from the IMF's World Economic Outlook Database (2016 April).

Gross government debt to GDP ratio

We use the general government gross debt as shares of GDP from the IMF's World Economic Outlook Database (2016 April).

GDP gap

This variable is calculated by difference rate between actual GDP and potential one. Actual GDP is the gross domestic product evaluated by constant prices from the IMF's

World Economic Outlook Database (2016 April) and potential GDP is calculated using the Hodric-Prescott filter with the smoothing parameter set 6.25, which value is recommended for annual data by Ravn and Uhlig (2002).

The formulation of GDP gap is the following; $GDP\ gap = \frac{GDP - GDP^{trend}}{GDP}$.

Government expenditure gap

This variable is calculated by difference rate between actual government expenditure and potential one. Actual government expenditure is the general government total expenditure from the IMF's World Economic Outlook Database (2016 April), which consists of total expense and the net acquisition of nonfinancial assets. Potential government expenditure is calculated using the Hodric-Prescott filter with the smoothing parameter set 6.25. The formulation of GDP gap is the following;

$GOVE\ gap = \frac{GOVE - GOVE^{trend}}{GOVE}$.

Inflation rate

We use inflation rate calculated as annual change of average consumer prices from the IMF's World Economic Outlook Database (2016 April). We take the average in the previous three years of inflation rate.

Trade openness

Trade openness is calculated by sum of export and import to GDP and its data source is World Bank's World Development Indicators. We take the average in the previous three years of the trade openness.

Trend GDP growth

We make this variable as the growth rate of the potential GDP calculated above.

Current account balance

We use the current account balance as shares of GDP from the IMF's World Economic Outlook Database (2016 April). Current account is all transactions other than those in financial and capital items. The major classifications are goods and services, income and current transfers. We take the average in the previous three years of current account balance.

Figure 1: GDP Growth and Interest Rates in Japan

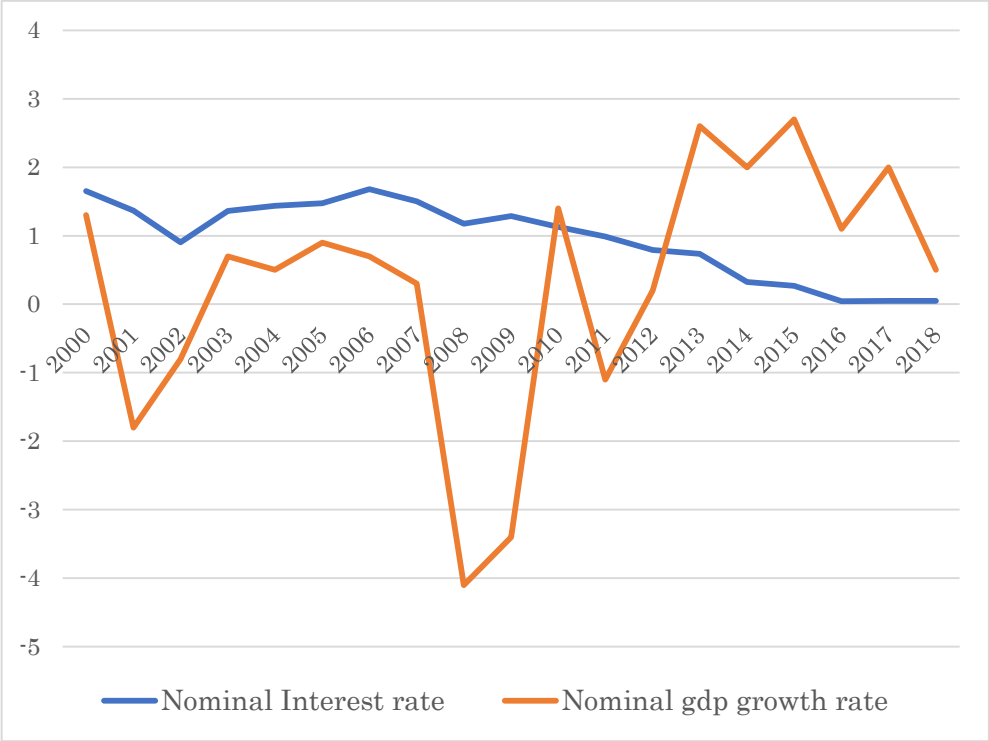

Figure 2: GDP Growth and Interest Rates in 23 OECD Countries

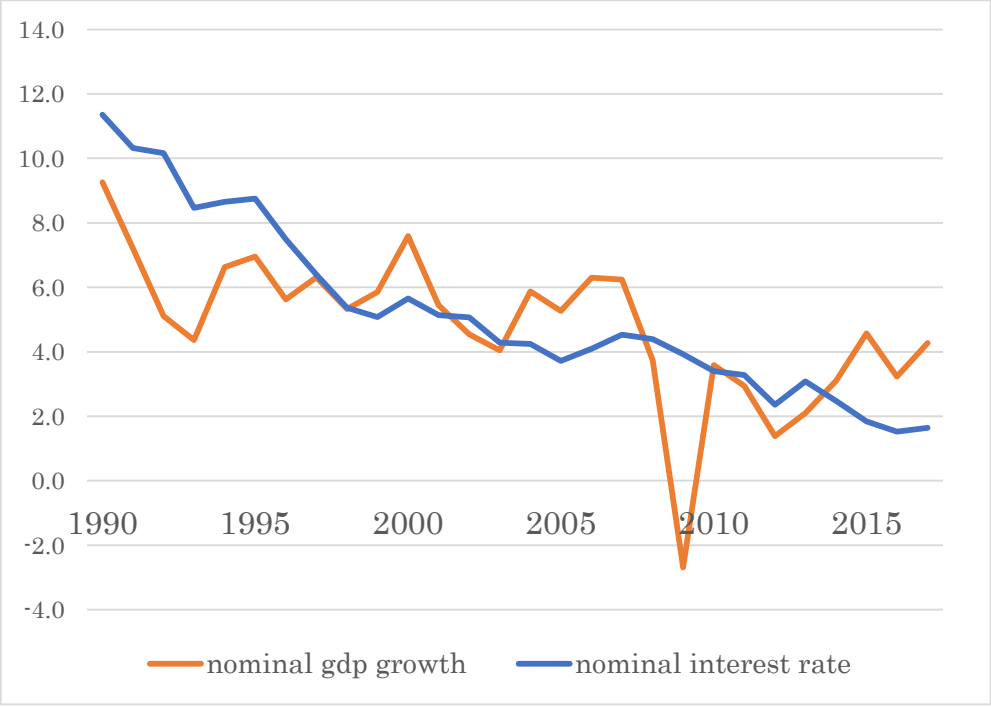

Figure 3: Image of Debt Dynamics

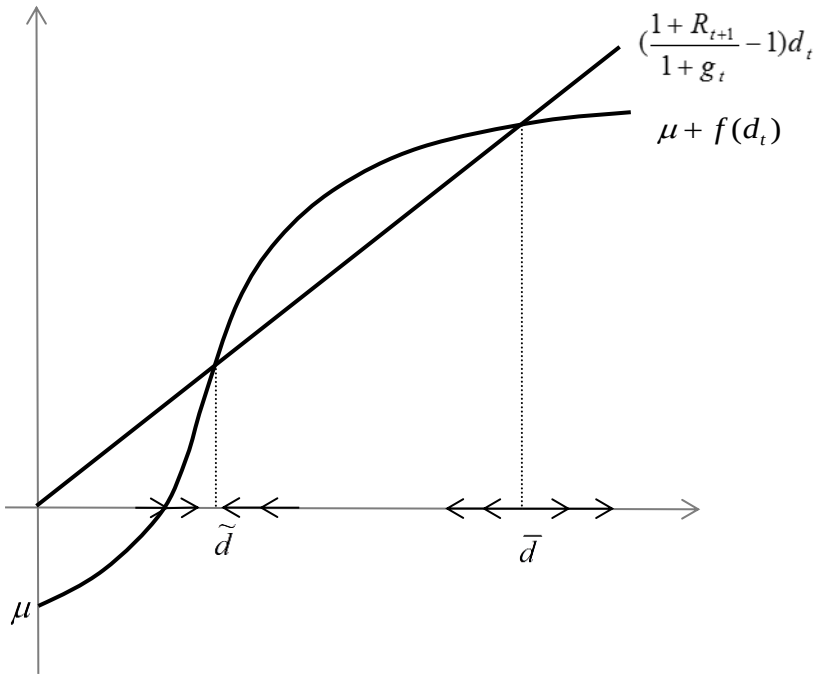

Figure 4: Estimated Reaction Function

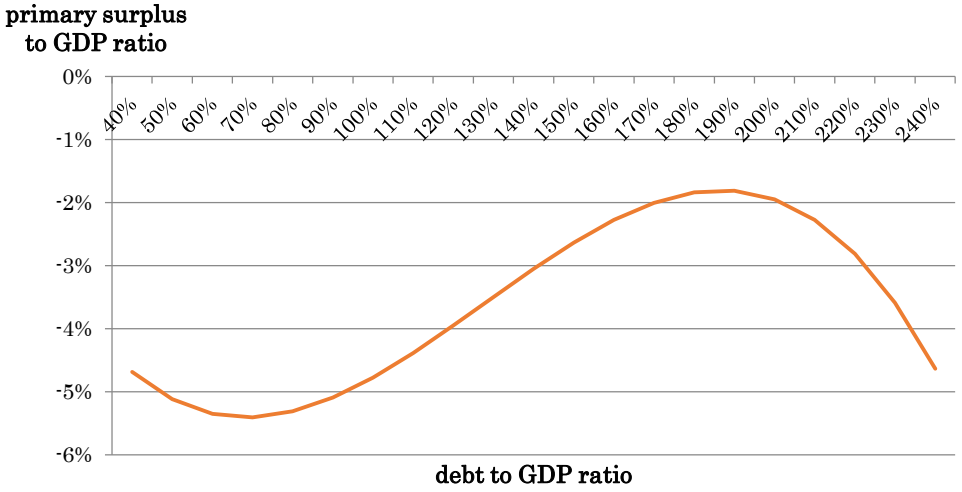

Figure 5. Plotting observations and the estimation

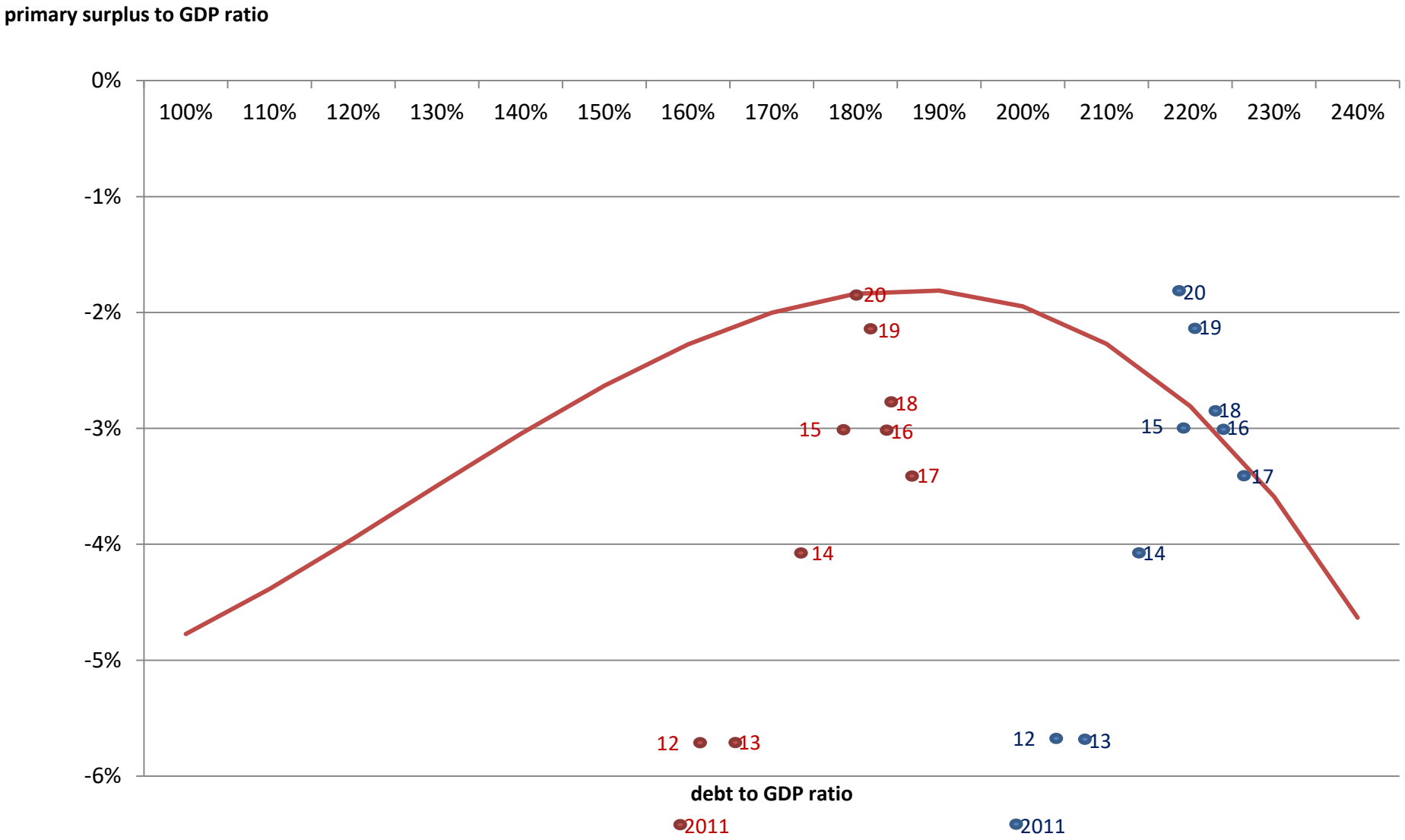

Figure 6. Graphic image in “fast-growth” scenario

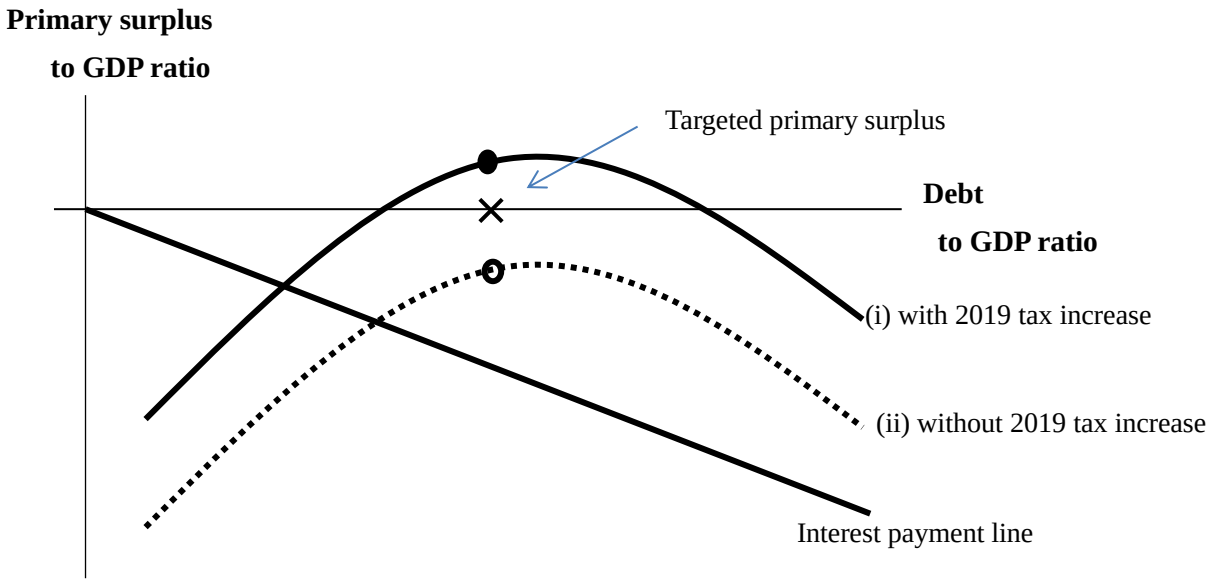

Figure 7. Graphic image in “baseline” scenario

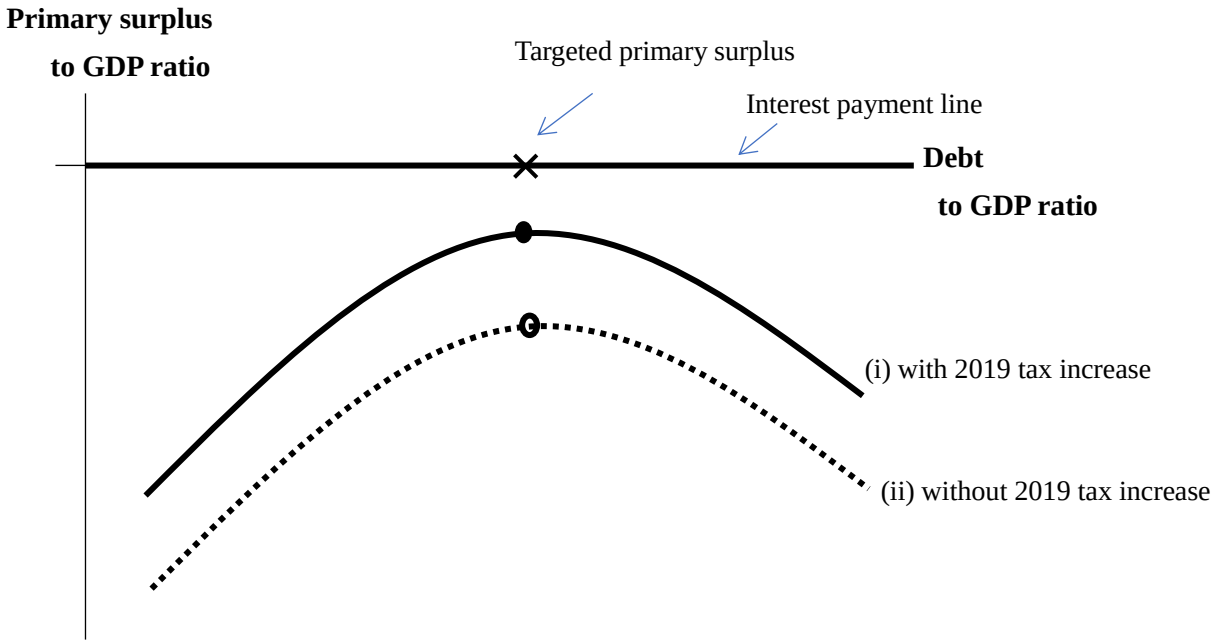

Table 1. Estimations of Fiscal Reaction Funtion

Estimation	1	2	3
Sample period	1985-2014	1985-2014	1985-2014
lagged debt	-0.116 **	-0.166 ***	-0.123 ***
	(0.046)	(0.043)	(0.043)
lagged debt_square	0.121 **	0.166 ***	0.126 ***
	(0.048)	(0.045)	(0.045)
lagged debt_cubic	-0.032 **	-0.043 ***	-0.034 ***
	(0.014)	(0.013)	(0.013)
lagged debt			-0.327 ***
* sovereign dummy			(0.068)
lagged debt_square			0.472 ***
* sovereign dummy			(0.103)
lagged debt_cubic			-0.159 ***
* sovereign dummy			(0.038)
output gap	0.481 ***	0.446 ***	0.467 ***
	(0.043)	(0.043)	(0.043)
govt. expenditure gap	-0.430 ***	-0.415 ***	-0.369 ***
	(0.020)	(0.020)	(0.021)
inflation		0.162 **	0.138 *
		(0.072)	(0.072)
trade openness		-0.001	-0.002
		(0.022)	(0.021)
trend GDP		0.865 ***	0.881 ***
		(0.146)	(0.143)
curent account		0.187 ***	0.179 ***
		(0.061)	(0.060)
observations	570	570	570
number of countries	23	23	23
R-squared	0.156	0.343	0.386
AR(1) coefficient	0.866	0.812	0.807
sigma_e	0.016	0.015	0.015

Notes) The dependent variable is the primary balance to GDP ratio. Estimation method is fixed effects model with assuming AR(1) error structre. Standard errors are reported in parentheses; ***, ** and * denote statistically significance at 1, 5, and 10 percent level, respectively. Soveriegn dummy takes the value one for five countries (PIIGS; Portugal, Ireland, Italy, Greece and Spain) and for three years (2010-2012) and zero otherwise.

Table 2: Calculation Results

	Fast-growth case	Baseline case
(A) Government projection at 2025		
Real GDP growth rate	2.0%	1.1%
Inflation rate	1.4%	0.5%
Real interest rate	0.7%	1.1%
Debt / GDP	166.6%	182.6%
Primary surplus / GDP	-0.2%	-1.1%
Real interest rate – real GDP growth rate	-1.3%	0.0%
(B) Calculated primary surplus		
(i) with 2019 consumption tax increase	0.4%	-0.3%
(ii) without 2019 consumption tax increase	-0.5%	-1.1%