Defying Gravity:
How Long Will Japanese Government Bond Prices Remain High?

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http://www.nber.org/papers/w18287

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Questions

1. Recent economic research shows the Japanese fiscal situation is not sustainable, but why do JGBs prices remain high, defying gravity?
2. What are the factors that make defying gravity?
3. Will JGBs continue to defy gravity? How long?
4. If not, what will be a trigger for change?
5. How will the crisis (if it happens) look like?

Answers — in advance

1. High debt-to-GDP ratio with low JGB yields, supported by:
   - Large private sector domestic savings with home bias
   - And the expectation of future fiscal consolidation before the government debt reaches the ceiling of private sector domestic savings
2. Favorable conditions do not last long as the private saving rate continues to decline as a result of aging and population decline
3. A debt crisis will happen at latest when the government debt reaches the ceiling of private sector saving
4. A debt crisis will happen earlier when the expectation changes
   1. How to finance the reconstruction after the earthquake/tsunami disaster can be critical
5. When the crisis happens, the government will be forced to respond with fiscal austerity

Major assumptions on simulation

- Tax-GDP ratio
  - Constant at 30% (Alternative, if gradually raised to 46% by 2029)
- Government expenditures excluding interest payments
  - Doi-Hoshi projections
- Real Interest rate on JGP:
  - Growth rate + premium
- Household saving-GDP ratio:
  - gradual decline from +3% in 2010 to -3% in 2040
- GDP growth rate (demographic decomposition):
  - Labor productivity growth (1.05% (low scenario) or 2.09% (high scenario)
- Corporate saving rate:
  - The balance will not change from 2010

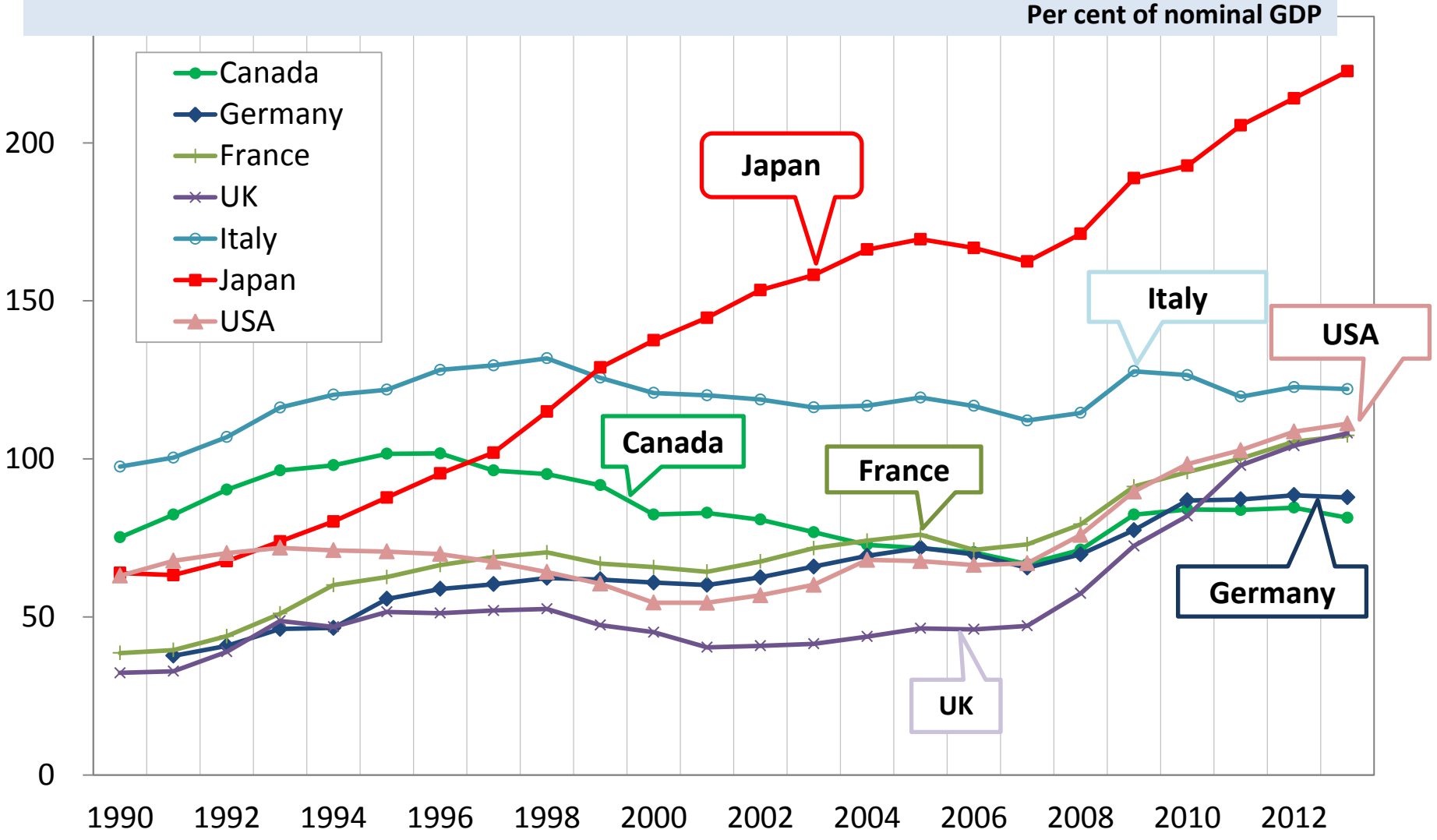
Summary

- Debt crisis (= government debt < Private Saving) will come by 2023, in case of no fiscal consolidation effort
- The government can stabilize the debt-GDP ratio, if the tax burden is increased from 30% to 46% by2029
- The impact of the Great Eastern Earthquake on the budget is not so large, but if handling of this changes expectation of future tax increases, then it may affect adversely expectation for future tax increases—thus, hasten the crisis.

Facts

- Gross Debt/GDP ratio, about 200%, the worst among the OECD
- Net Debt/GDP ratio, about 120%, the worst among the OECD
- Fiscal deficit is about 7% of GDP in the last three years
- New bond issues exceeds the tax revenues in the last two years
- Yet, the JGB yield is low (price is high), despite the very bad fiscal situation

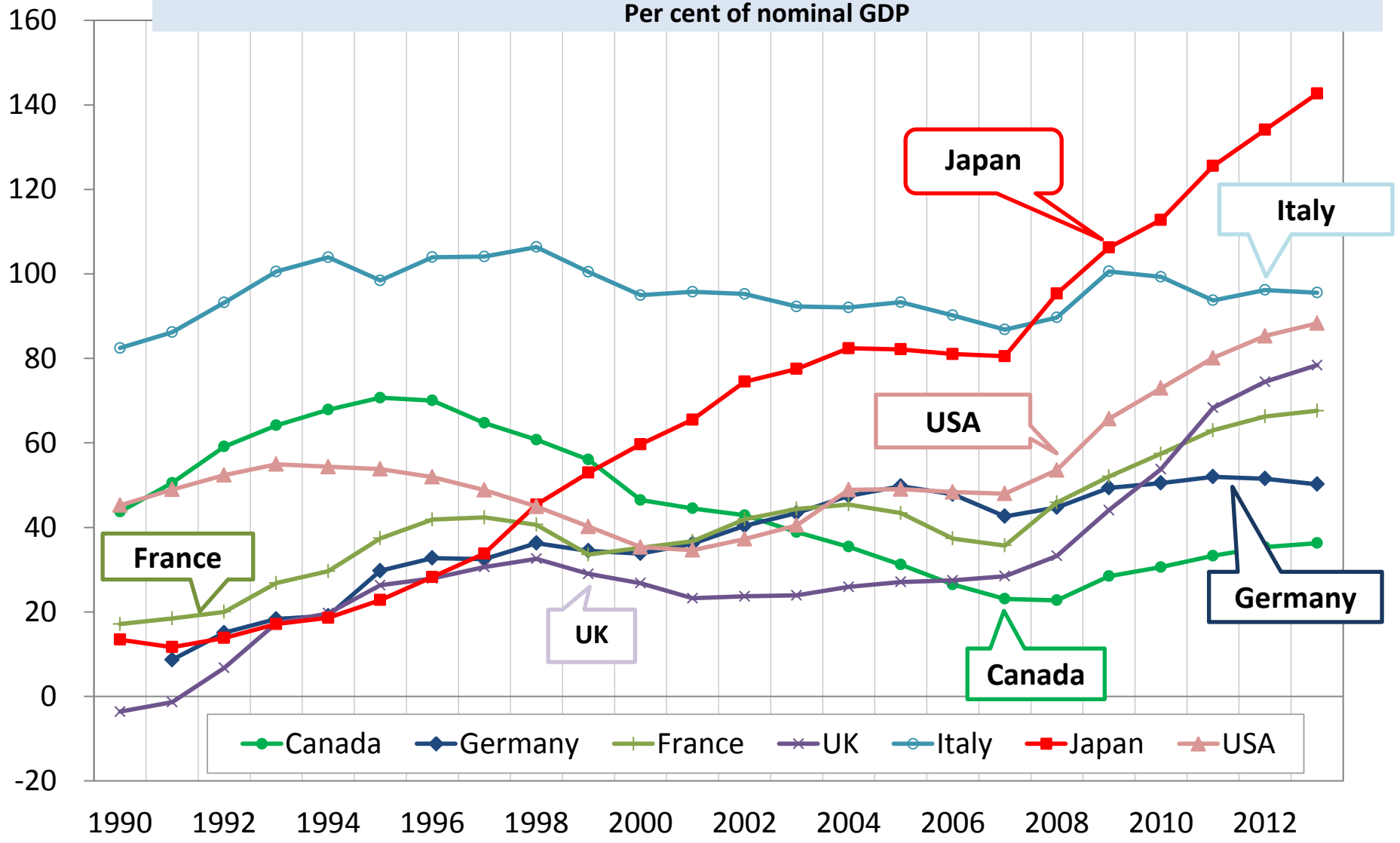
General government gross financial liabilities



Source: OECD Economic Outlook 91 database.

General government net financial liabilities

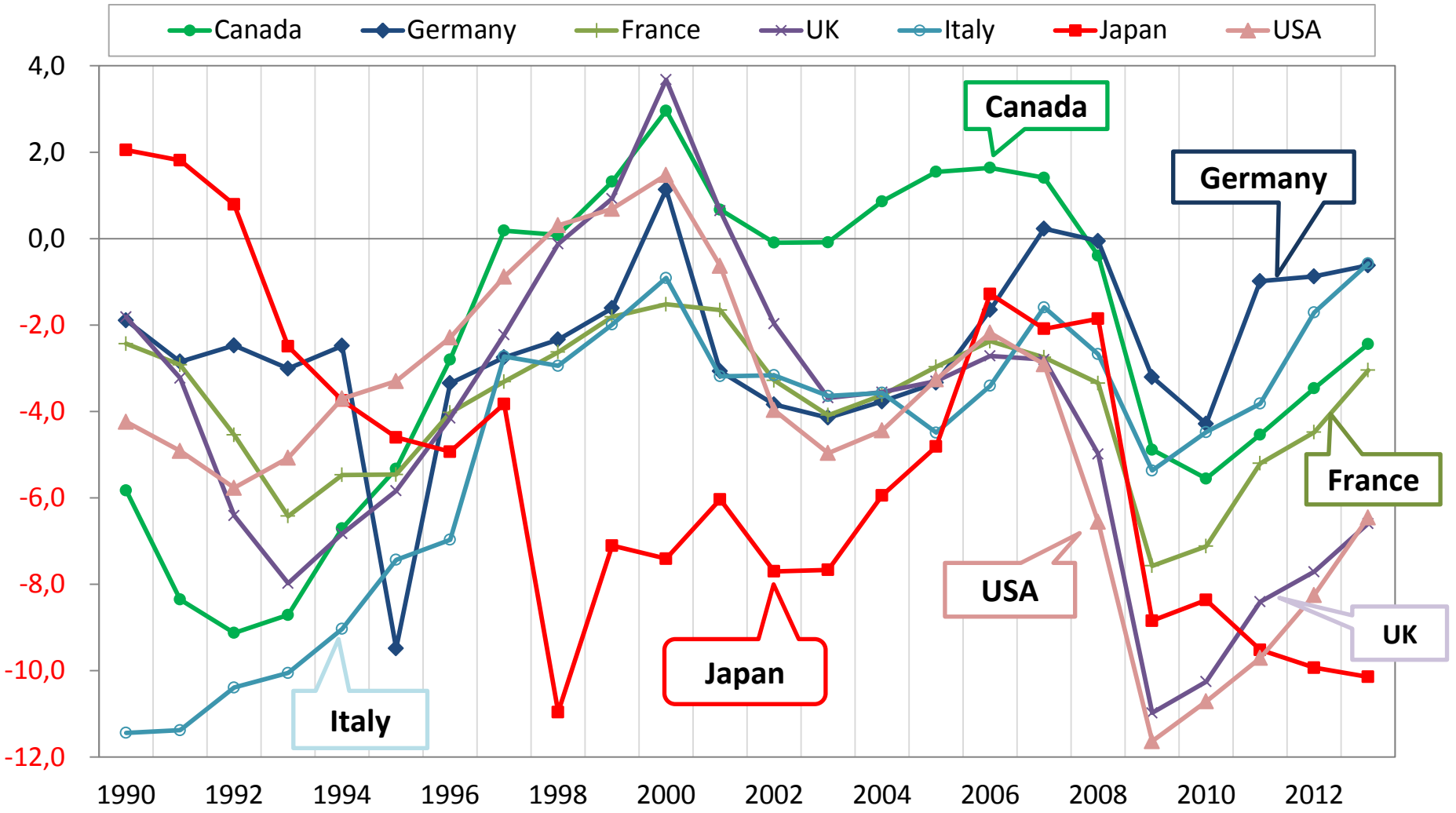
Per cent of nominal GDP



Source: OECD Economic Outlook 91 database.

General government financial balances

Surplus (+) or deficit (-) as a per cent of nominal GDP



Source: OECD Economic Outlook 91 database.

Recent Empirical Studies

- Broda and Weinstein (2005), Doi (2009), Doi, Hoshi and Okimoto (2011)
- Imrohoroğlu and Sudo (2011), Hosono and Sakuragawa (2011)
- Doi and Ihori (2009), Ito (2011), Ito, Watanabe and Yabu (2011)
- Ostry et al. (2010), Gagnon (2011), IMF (2011)
- All of them shows the Japanese fiscal situation is unsustainable

Table 1. Different concepts of Government liabilities

National Liabilities: JGB, Borrowings and Guarantees as reported to IMF		
At the end of March 2011	(Trillion yen)	ratio to GDP
Longterm Liability of National Government		
JGB	636.3	
Zaito Bonds	118.2	
Others(*)	59.1	
Financing Bills (**)	110.8	
Government guarantee	44.7	
Total	**969.1**	202%
GDP(2010)	479.0	

(Source) The Ministry of Finance, homepage http://www.mof.go.jp/english/jgbs/reference/gbb/e2303.html

(*) Others includes government bonds that are issues as capital of public entities (Kofu Kokusai) and borrowings

(**) Financing Bills are issued primarily to fund the foreign reserves that are held in the special account of the government. They are rolled over every 3 months, and considered to be short-term liabilities that have assets, that is foreign reserves, to match the liabilities. FBs should be excluded from long-term liabilities, and from "net" government liabilities.

National and Local Government Longterm liability (to be redeemed by mainly future		
Forecast for March 2012	(Trillion yen)	ratio to GDP
Longterm Liability of National Government		
JGB	668.0	
Zaito Bonds (**)	Not included	
Others (*)	24.0	
Financing Bills (**)	Not included	
Government Guarantee	Not included	
Local, Long-term liabil	200.0	
Total	**892.0**	186%

Source: Ministry of Finance(2011), Government Liabilitiy Management Report 2011, p.86 http://www.mof.go.jp/jgbs/publication/debt_management_report/2011/index.htm (in Japanese)

(*) Borrowings for accounts to be distributed to local governments (Kofu tax), about 34 trillion yen, is categorized in the local liabilities instead of National government liabilities

(**) Zaito bonds are not included because they are in theory repaid from income from government investment; Financing bills are not incuded because they are short-term, and also they are backed by assets (foreign reserves); and gouarantee is not included because they are only contingent liabilities.

General Government Gross Liability (National Account concept)		
End of March 2010	(Trillion yen)	ratio to GDP
National Government Liabilities		
JGB (+)	559	
Zaito Bonds	Not included	
Others (*)	63	
Financing Bills and Discount Bonds(+)	149	
Government Guarantee (**)	54	
Local liabilities	183	
Liabilities in Social Security Fund	15	
Total	**1,023**	214%

Source: Ministry of Finance(2011), Government Liabilitiy Management Report 2011, p.86 http://www.mof.go.jp/jgbs/publication/debt_management_report/2011/index.htm (in Japanese)

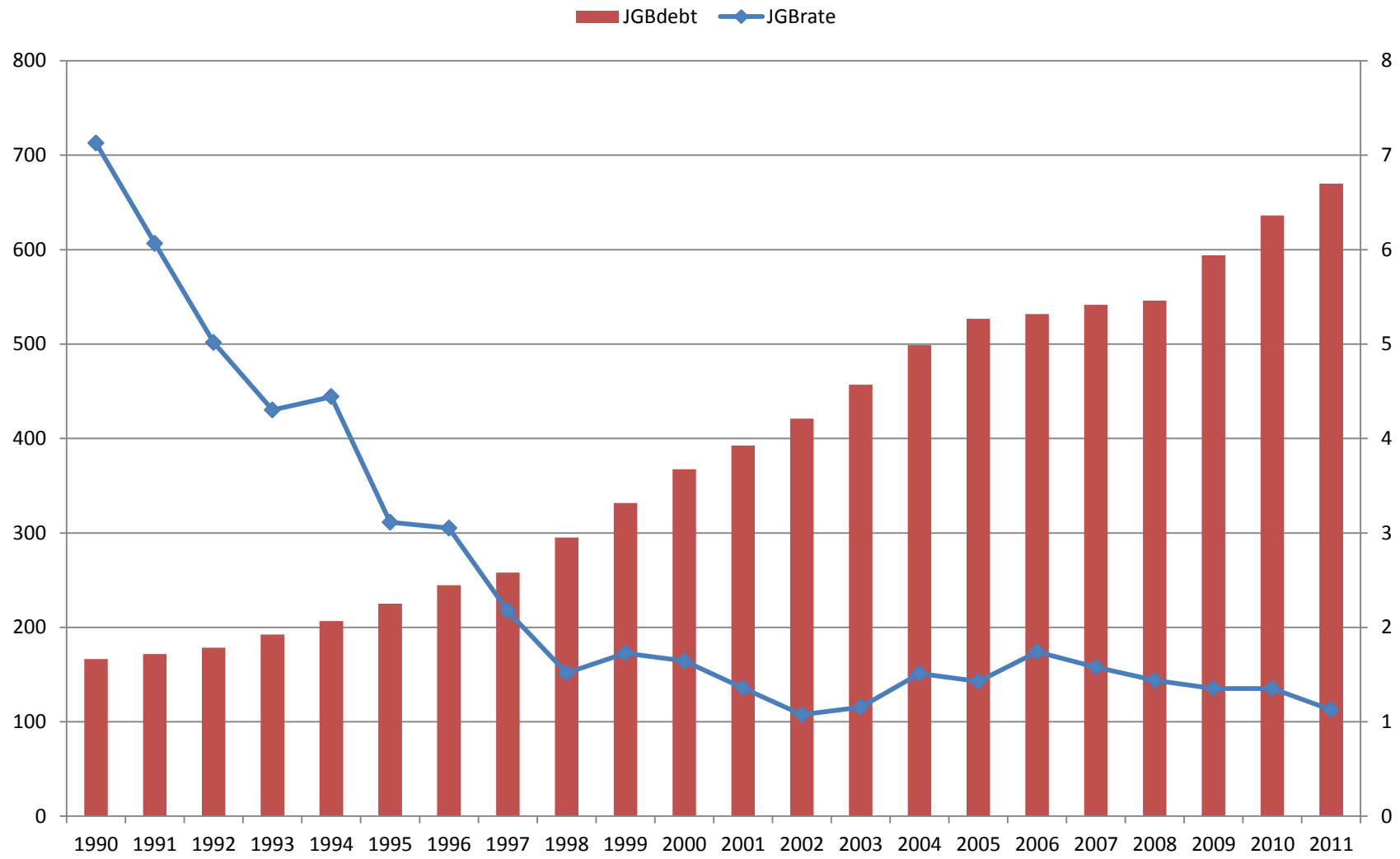
(+) Short-term discount bonds are excluded from JGB and included in Financing bills and discount bonds

(*) Others include borrowings for accounts to be distributed to local governments (Kofu tax), about 34 trillion yen.

(**) Government guarantee includes liabilities at the public agencies (Dokuritsu Gyosei Hojin)

File: JGBRiskFigTab*.xlsx

As the amount of JGBs increased, the yield stayed low (or fell). Why?



Why is the JGB yield so low?

- Reasons for "defying gravity"
  - Traditionally, high private sector domestic savings
  - Home bias of Japanese investors
  - And the expectation of fiscal consolidation in the near future to make the fiscal policy sustainable
- Reasons why it would not continue forever
  - High private sector domestic savings will not continue forever; there is absolute ceiling
  - When the expectation (fiscal consolidation happens before the government debt reaches the ceiling of domestic private sector savings) changes, a crisis may happen earlier

Table 2. JGB holders—mostly domestic

	2005 March		2006 March		2007 March		2008 March		2009 March		2010 March	
	tril. Yen	(%)	tril. Yen	(%)	tril. Yen	(%)	tril. Yen	(%)	tril. Yen	(%)	tril. Yen	(%)
General Government	2	0.3%	7.4	1.1%	3.6	0.5%	2.5	0.4%	2.5	0.4%	1.9	0.3%
Public Pension	57.6	9.0%	61.5	9.2%	68.3	10.1%	78.1	11.2%	80.1	11.8%	76.3	11.2%
FILP	48.8	7.6%	39.4	5.9%	23.9	3.6%	10.9	1.6%	1.2	0.2%	0.8	0.1%
Postal Saving	109.7	17.1%	126.2	18.9%	140	20.8%	—	—	—	—	—	—
Postal Insurance	55.1	8.6%	57	8.5%	61	9.1%	—	—	—	—	—	—
Bank of Japan	92.1	14.3%	86.7	13.0%	71	10.6%	63.7	9.2%	55.9	8.2%	51.2	7.5%
Private Financial Institutions	218.6	34.1%	218.5	32.7%	216.1	32.1%	439.7	63.3%	441.6	64.9%	464.5	68.1%
banks	111.6	17.4%	114.5	17.2%	101.6	15.1%	246.4	35.5%	246.2	36.2%	258.7	37.9%
insurance	54.8	8.5%	58.4	8.7%	61.8	9.2%	129.2	18.6%	135.1	19.8%	139.9	20.5%
private pension funds	21.3	3.3%	24	3.6%	26.2	3.9%	26.8	3.9%	25.6	3.8%	28	4.1%
others	31	4.8%	21.6	3.2%	26.5	3.9%	37.3	5.4%	34.7	5.1%	37.9	5.6%
Overseas	26.4	4.1%	30.2	4.5%	40.2	6.0%	47.4	6.8%	43.9	6.5%	31.6	4.6%
Household	21.8	3.4%	28	4.2%	33.4	5.0%	36.3	5.2%	36	5.3%	34.4	5.0%
Others	9.6	1.5%	12.4	1.9%	15.2	2.3%	16.5	2.4%	19.6	2.9%	21.4	3.1%
Total	641.8	100.0 %	667.3	100.0 %	672.7	100.0%	695	100.0 %	680.9	100.0 %	682.1	100.0 %

Table 3 Determinants of JGB (10-yr) Yields

10yr Bond yield ↑ when Gross Debt ↑,
Net private financial asset ↓
Foreign shareholding ↑

Variable	Gross debt including FILP	JGB held by Bank of Japan	Net financial wealth held by household and corporate sectors	Share of foreign holdings of JGBs	R square
Estimate	0.02	0.01	-0.02	0.11	0.38
t-stat	(3.52)***	(0.36)	(-3.37)***	(2.06)**	

Tokuoka (2010) Table II.6

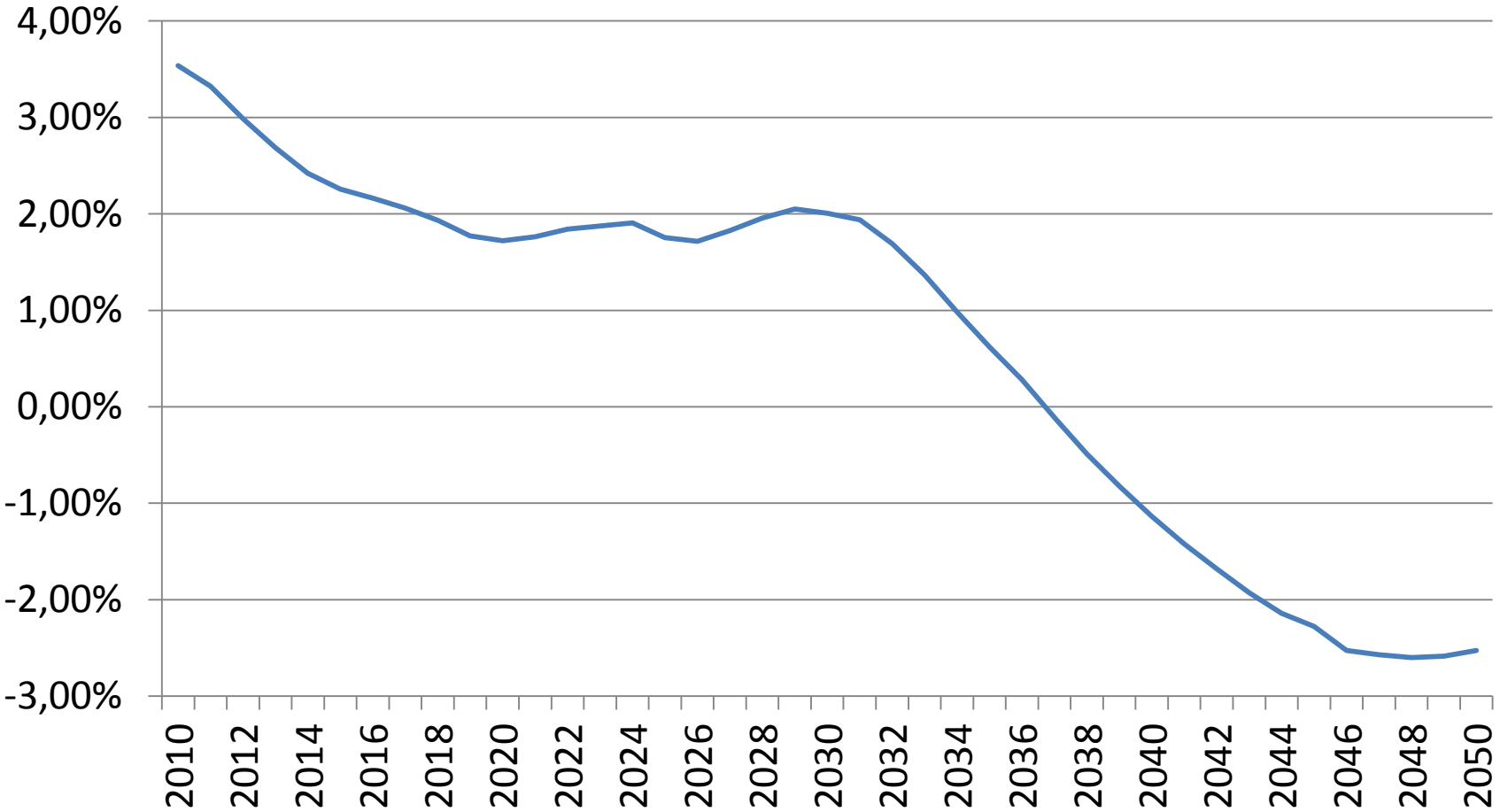
Period: 1998Q1 – 2009Q1

Notes: FILP is the government investment program, which used to be in the special account that were funded by Postal Bank surplus funds, and later became a part of government bond issues.

Limit to issuing Japanese government debt (without substantial interest rate increase)

- Because the household saving rate has started to decline and will continue to decline (consequence of rapid aging)
- Situation that domestic investors hold almost all of the Japanese government debt will not continue

Figure 4. Aggregate Saving to GDP Ratio: Projection, 2010-2050

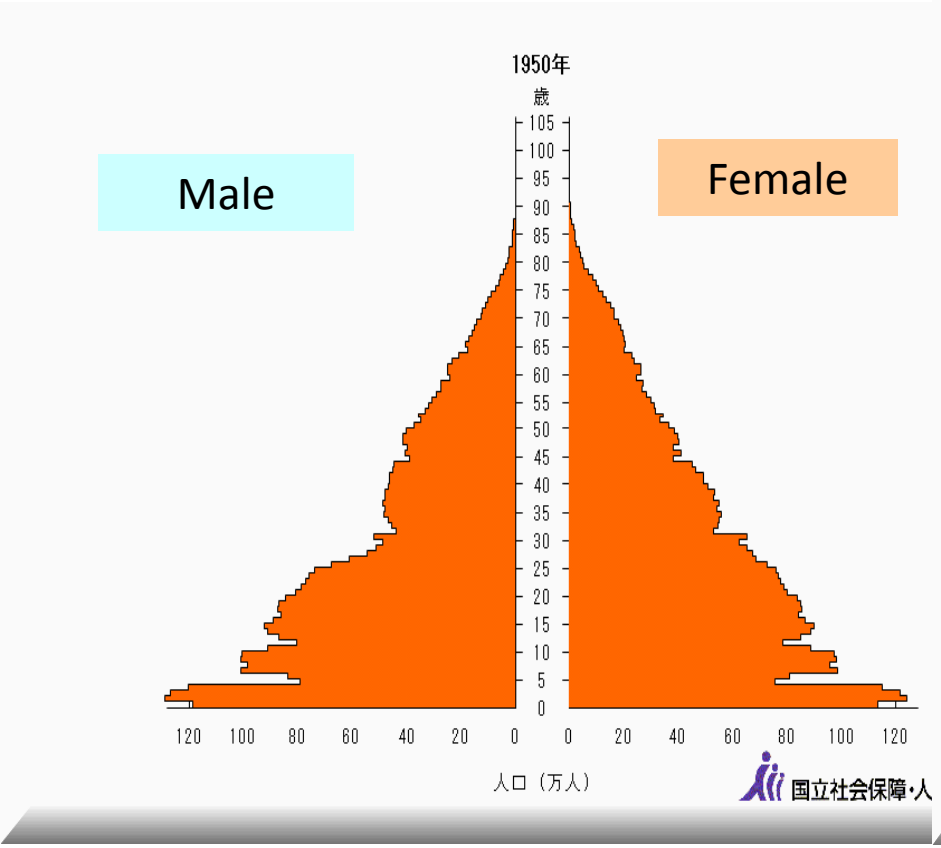


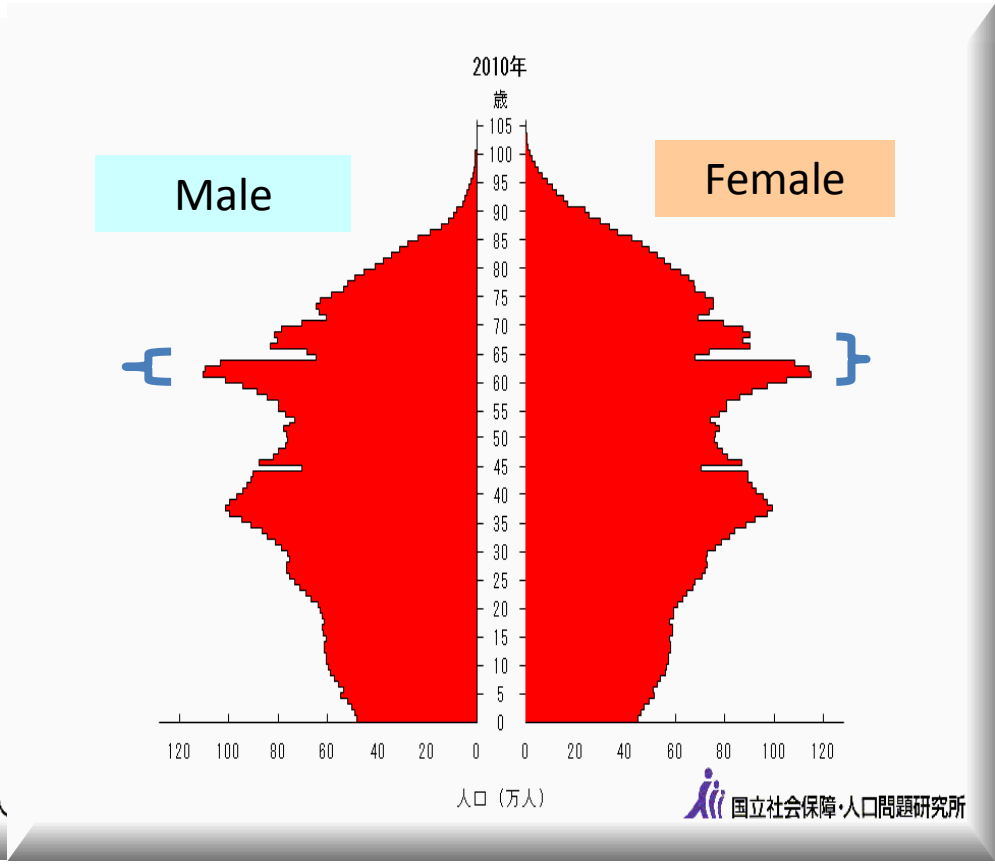
Demographic Change

- Low fertility rate
  - Increase in never-married singles
  - Increase in divorce rate
  - Decrease in the number of children per couples

1950 → 60 years later → 2010

Baby boomers' income is at the peak





Japanese Population Structure: 2040

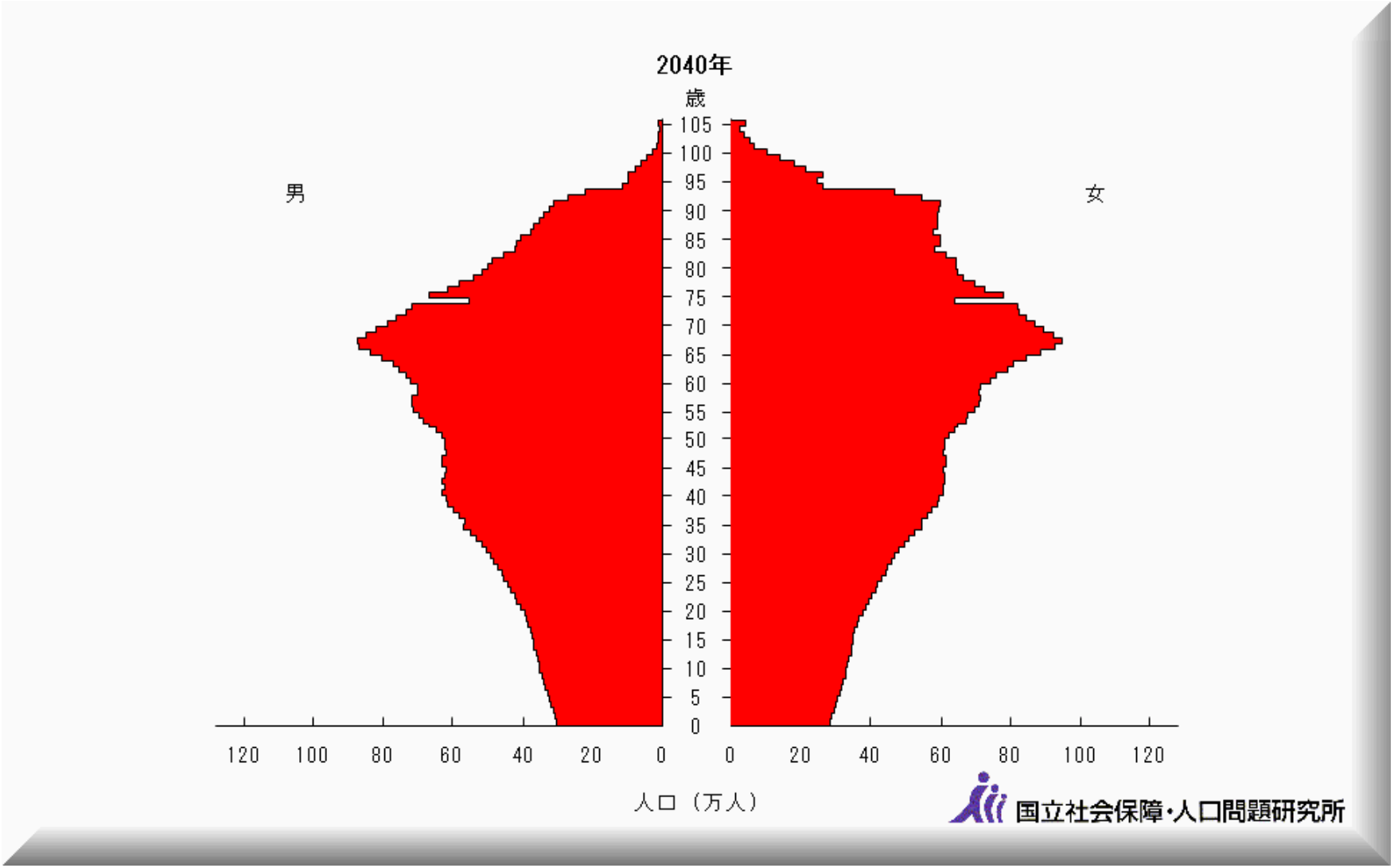


Figure A1. Saving Rate by Household Age Bracket, 60+ yrs old are dissaver

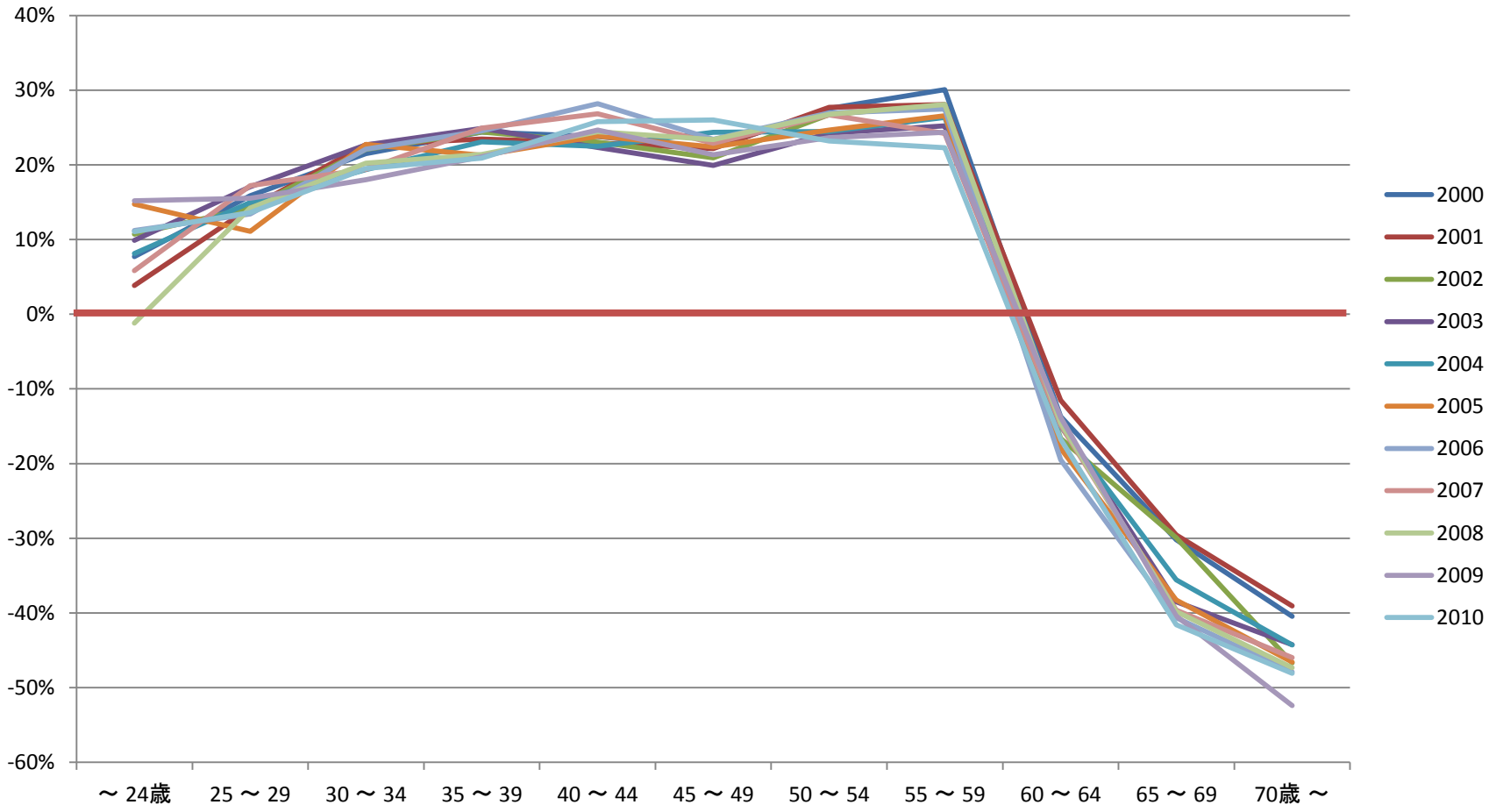
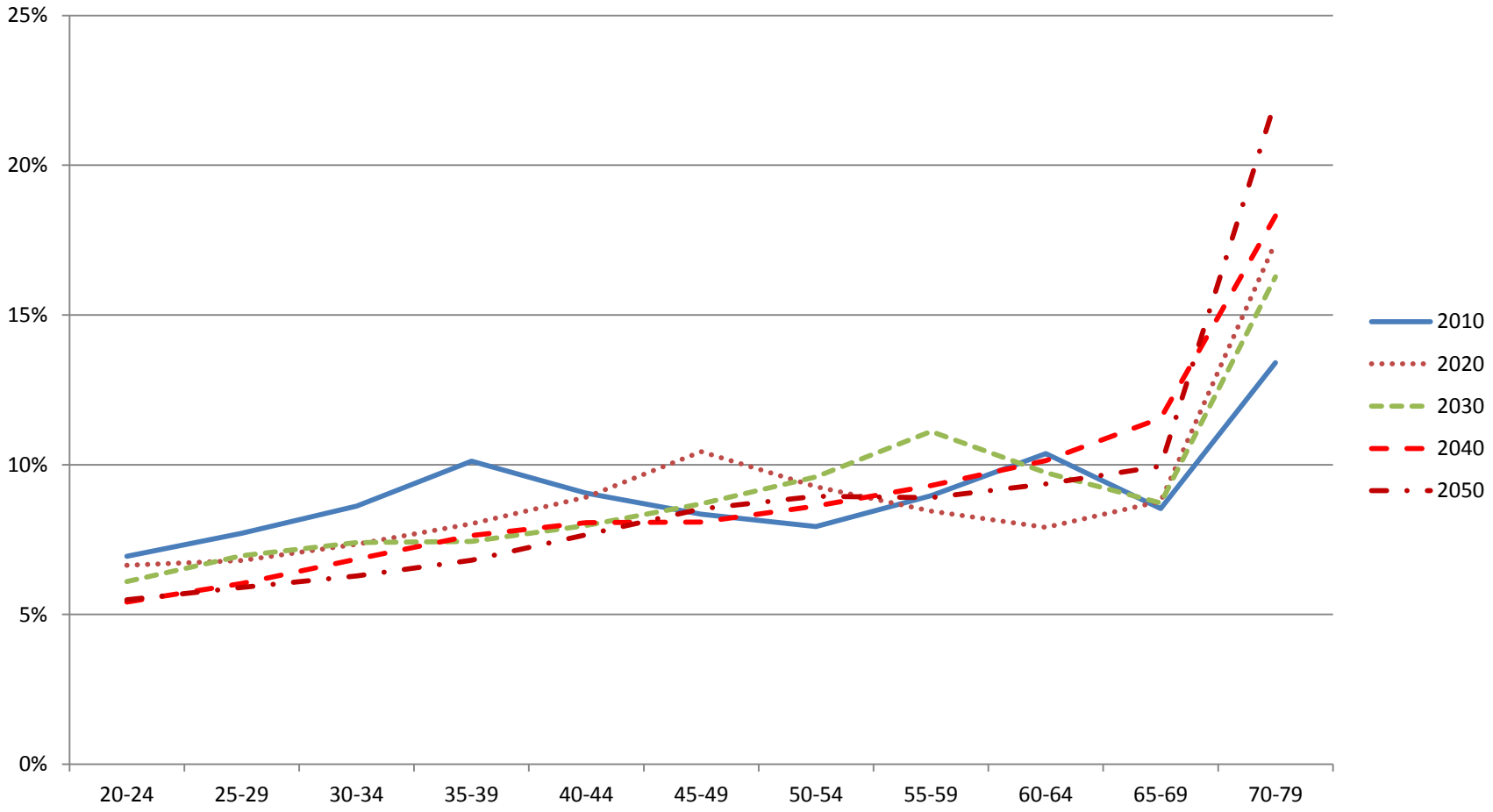


Figure A2. Population Distribution

ratio of young ↓, ratio of old ↑



Demography turns against Japan

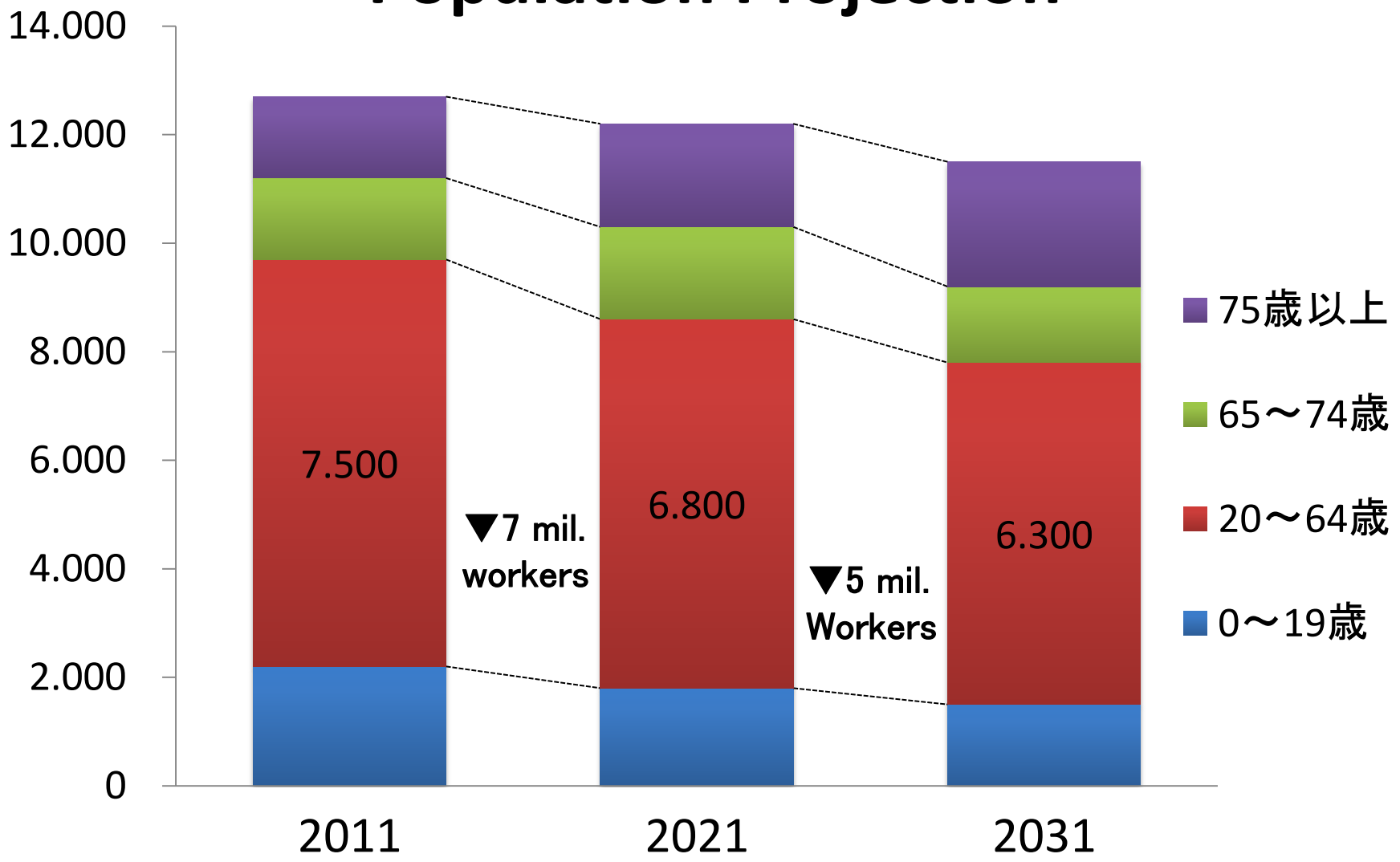
- Long history of low fertility; Lengthening life expectancy
  - Increasing population cohort of age 65 and over
  - Shrinking (in number of) working age population
- Implications
  - Increasing social security related expenditures under PAYGO plus tax subsidies to the system
  - Growth rate declines, holding labor productivity (output per working-age population) constant: (negative) demographic dividend

Table 4. History: Demographic Dividend in the past

	Δ rGDP	=	Δ POP	+	Δ (wPOP)/(POP)	+	Δ (rGDP/wPOP)
1955-1970	9.70%		1.00%		1.03%		7.77%
1971-1980	4.46%		1.22%		0.01%		3.46%
1981-1990	4.64%		0.55%		0.21%		3.75%
1991-2000	1.19%		0.27%		0.09%		1.16%
2001-2010	0.75%		0.02%		-0.49%		1.34%

But demography turns against growth in the future, due to the low and declining fertility rate and the lengthening longevity

Population Projection



Net Financial Assets

- Net financial assets of private sector =

  Net financial assets of the household sector – Value of shares and other equities held by the household sector + Cash, deposits, government bonds, and public corporation bonds held by the private nonfinancial sector

Debt dynamics and the ceiling of private sector financial assets

- Government debt: $b_{t+1} = \frac{1+r_t}{1+\eta_t} b_t + g_t - \tau_t$
- Private sector financial assets

$$a_{t+1} = \frac{1+r_t}{1+\eta_t} b_t + \max(a_t - b_t, 0) + s_t$$

  - Max operator, to distinguish the two cases
    - If a>b, {a-b} is added to a(t+1),
    - If a<b, then net liability {a-b} will not be added to a(t+1)
- Ceiling;

$$B_t - B_{t-1} \le S_{t-1} + (A_{t-1} - B_{t-1})$$

$$b_t \le \frac{s_{t-1} + a_{t-1}}{1+\eta_{t-1}}$$

Three Alternative Assumptions on the Future Interest Rates

R1: Interest rate stays at the level of 2010 (1.3%) as long as the growth rate does not exceed that level. When the growth rate exceeds 1.3%, the interest rate is equal to the growth rate.

$$r_t = \max(\eta_t, 1.3\%)$$

R2: Interest rate starts at 1.3%. For every 1% increase in the debt to GDP ratio over its level in 2010, the interest rate increases by 2 basis points (0.02%). Tokuoka (2010)

$$r_t = 1.3\% + 0.02*(b_t - 1.53)$$

R3: Interest rate starts at 1.3%. For every 1% increase in the debt to GDP ratio over its level in 2010, the interest rate increases by 3.5 basis points (0.035%). Gagnon (2010)

$$r_t = 1.3\% + 0.035*(b_t - 1.53)$$

Figure 5. Government Debt and Private Sector Financial Assets: 2010-2040 (2% GDP Growth)

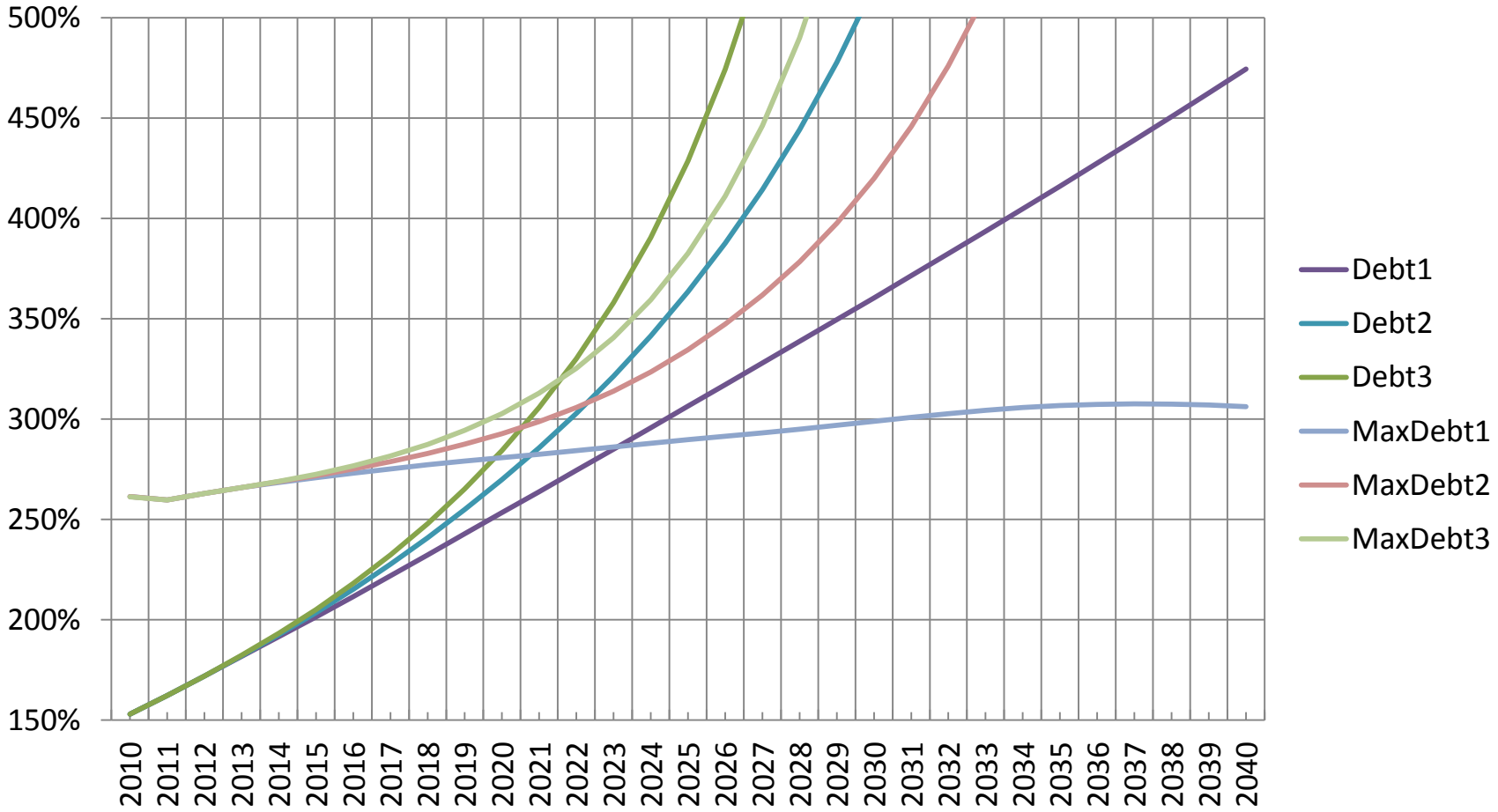


Table 5. Implication of 2% growth which is often used in government forecasts

	ΔrGDP	=	ΔPOP	+	Δ(wPOP)/(POP)	+	Δ(rGDP/wPOP)
2011–2020	2.00%		−0.35%		−0.65%		3.00%
2021–2030	2.00%		−0.63%		−0.13%		2.76%
2031–2040	2.00%		−0.86%		−0.76%		3.62%
2041–2050	2.00%		−1.05%		−0.49%		3.53%

Government forecasts

Implies →

Unrealistic per-worker productivity growth

Table 6. Growth per worker productivity at 1.05% to future

	⊿rGDP =	⊿POP +	⊿(wPOP /POP) +	⊿(rGDP /wPOP)
2011-20	-0.04%	-0.31%	-0.77%	1.05%
2021-30	0.27%	-0.62%	-0.15%	1.05%
2031-40	-0.47%	-0.83%	-0.68%	1.05%
2041-50	-0.45%	-0.99%	-0.50%	1.05%

Notes: Authors' calculation. Each row does not exactly add up as the equation suggests, due to approximation in ten-year average growth rates . ⊿POP and ⊿(wPOP/POP) are calculated from forecasts of IPSS, then ⊿(rGDP/wPOP) is assumed to be 1.05%, which was the average of 1994-2010. ⊿rGDP was derived from the identity;

Data Source: GDP from Cabinet Office, Japan for GDP ; and population from National Institute of Population and Social Security Research (IPSS).

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Figure 6. Government Debt and Private Sector Financial Assets: 2010-2040 (1.05% GDP per worker growth)

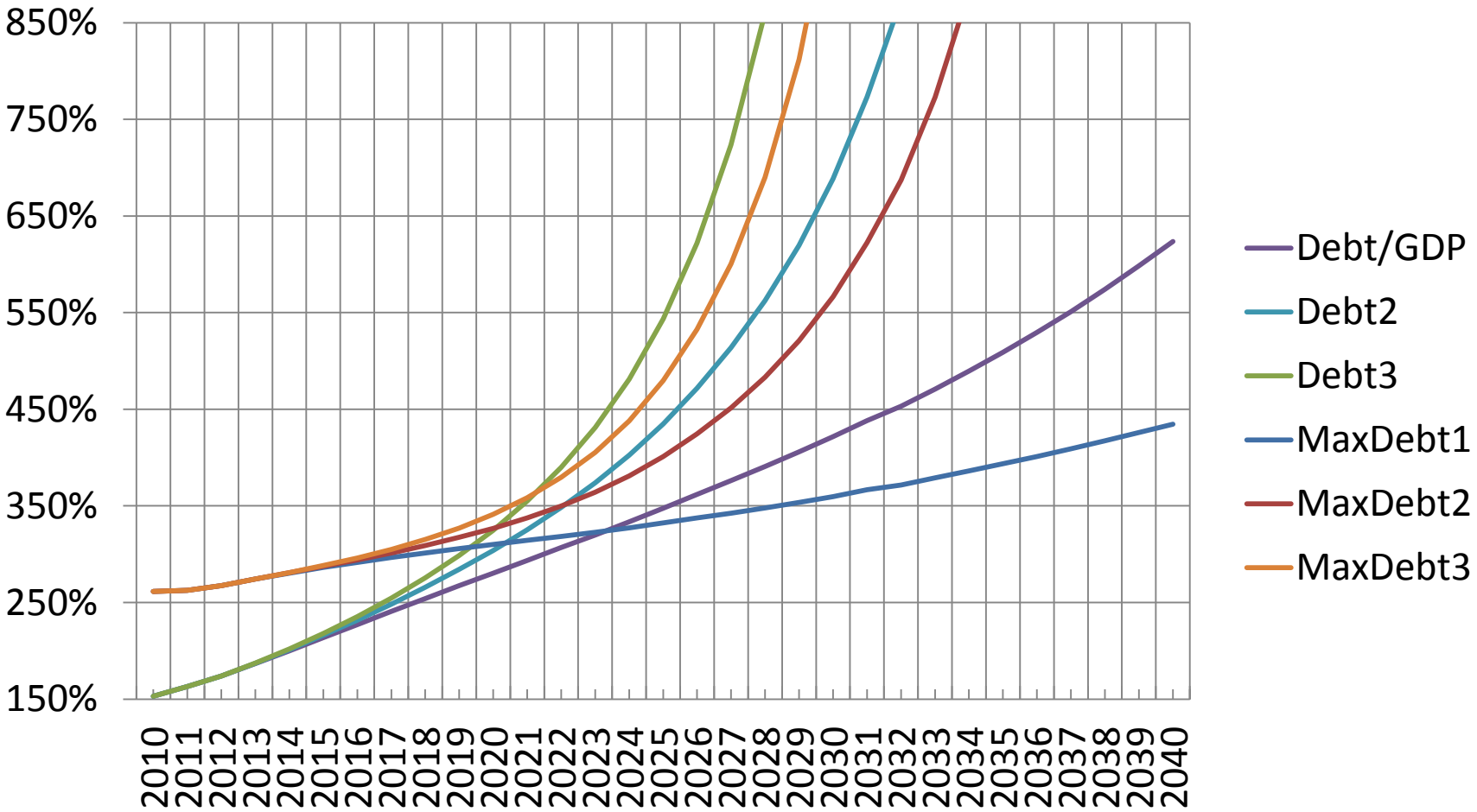

Table 7. Per-worker labor productivity increase of 2.09%

	⊿rGDP =	⊿POP +	⊿(wPOP /POP) +	⊿(rGDP /wPOP)
2011-20	0.98%	-0.31%	-0.77%	2.09%
2021-30	1.30%	-0.62%	-0.15%	2.09%
2031-40	0.55%	-0.83%	-0.68%	2.09%
2041-50	0.57%	-0.99%	-0.50%	2.09%

Notes: Authors' calculation. Each row does not exactly add up as the equation suggests, due to approximation in ten-year average growth rates . ⊿POP and ⊿(wPOP/POP) are calculated from forecasts of IPSS, then ⊿(rGDP/wPOP) is assumed to be 2.09%, which was the average of 2001-2007. ⊿rGDP was derived from the identity;

Data Source: GDP from Cabinet Office, Japan for GDP ; and population from National Institute of Population and Social Security Research (IPSS)

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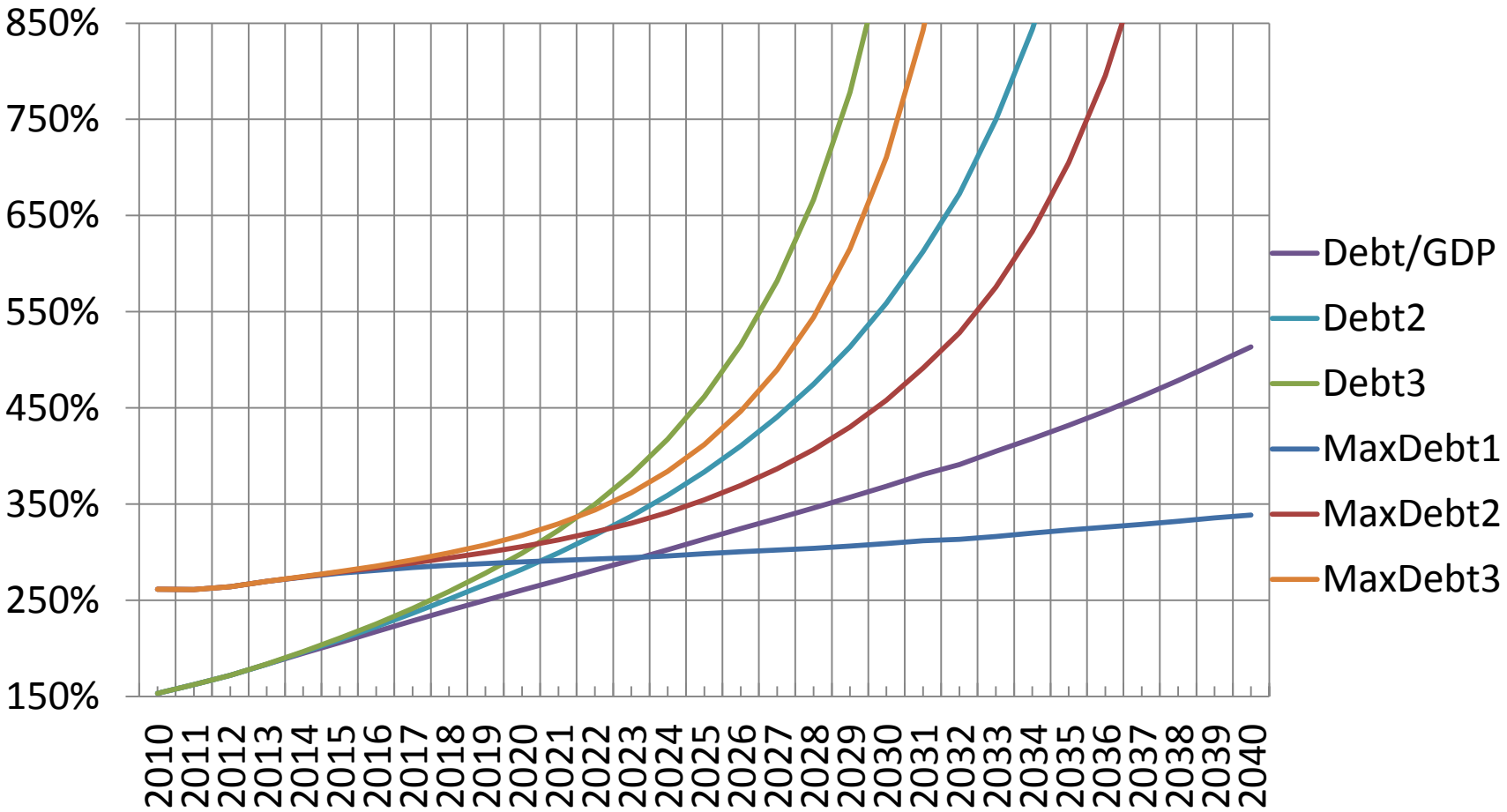
Figure 7. Government Debt and Private Sector Financial Assets: 2010-2040 (2.09% GDP per worker growth)



Expectation of future fiscal consolidation

- We show the existence of an expected path of future tax rates that eventually stabilize the debt to GDP ratio
- If the market currently has such expectation, the absence of crisis for JGB is understandable
- If the expectation changes (and this often happens suddenly and unexpectedly), this will result in a crisis

Figure 8. Sustainable Tax Policy under Each Interest Rate Assumption

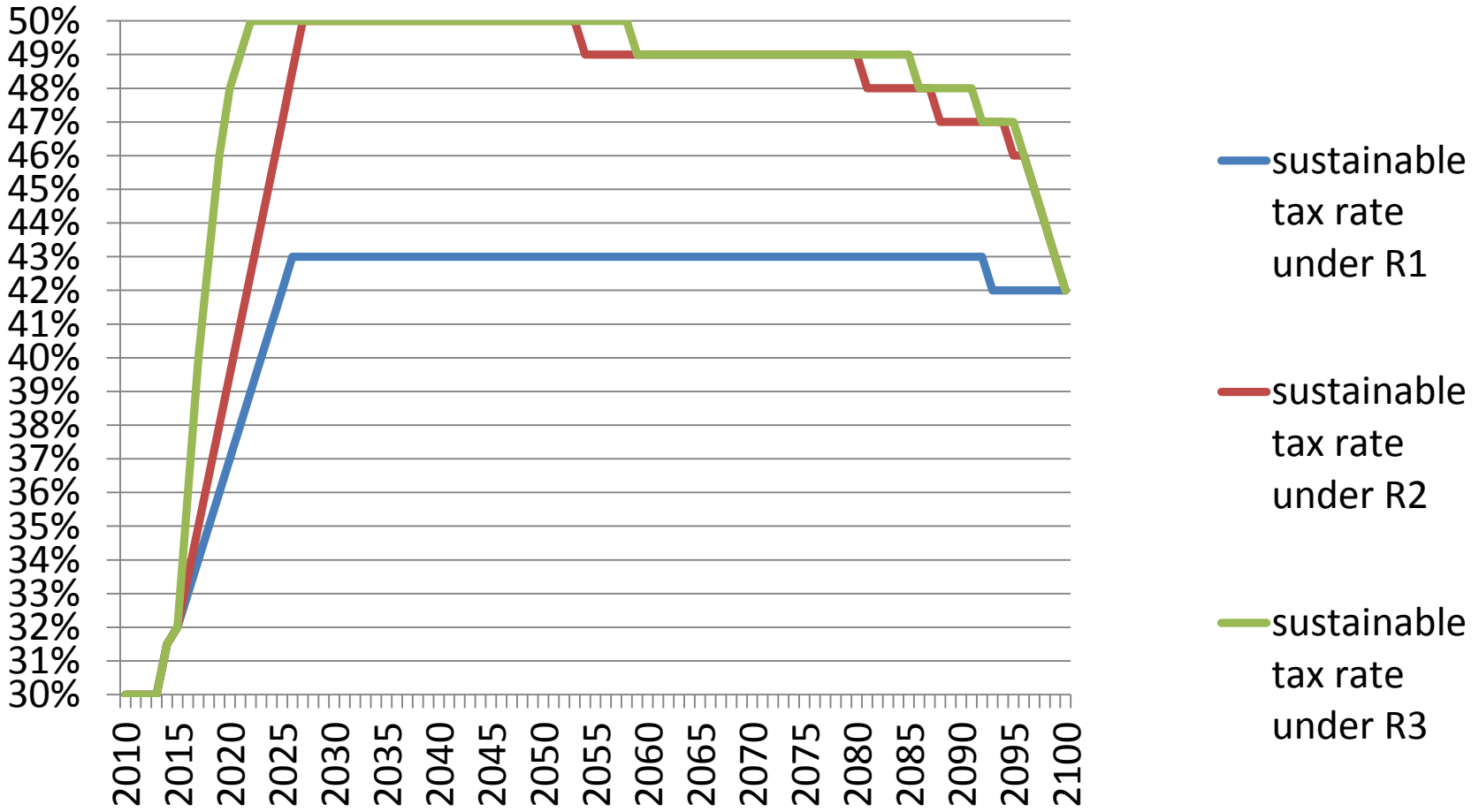


Figure 9. Debt/GDP Ratio with Sustainable Tax Policy

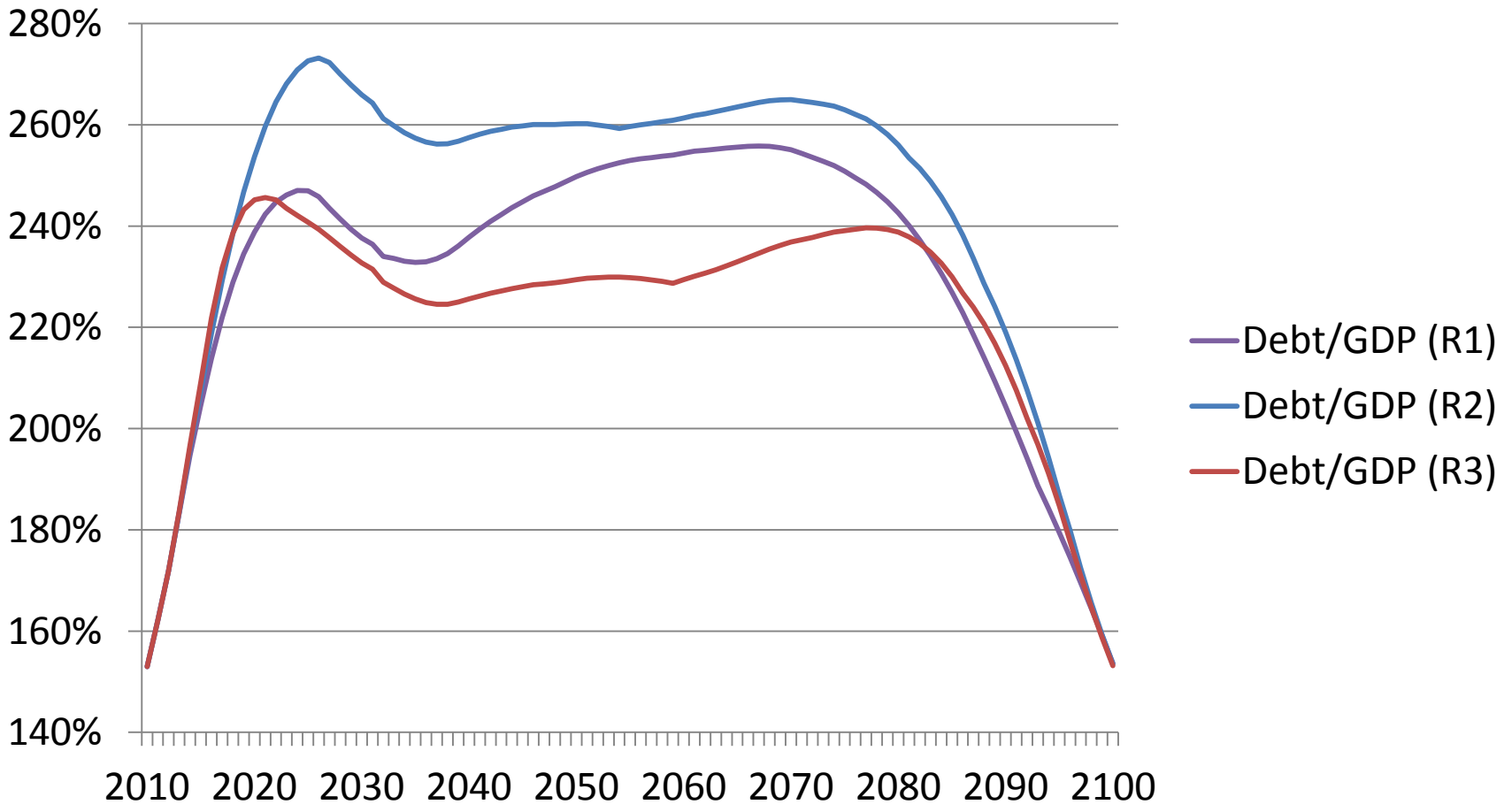
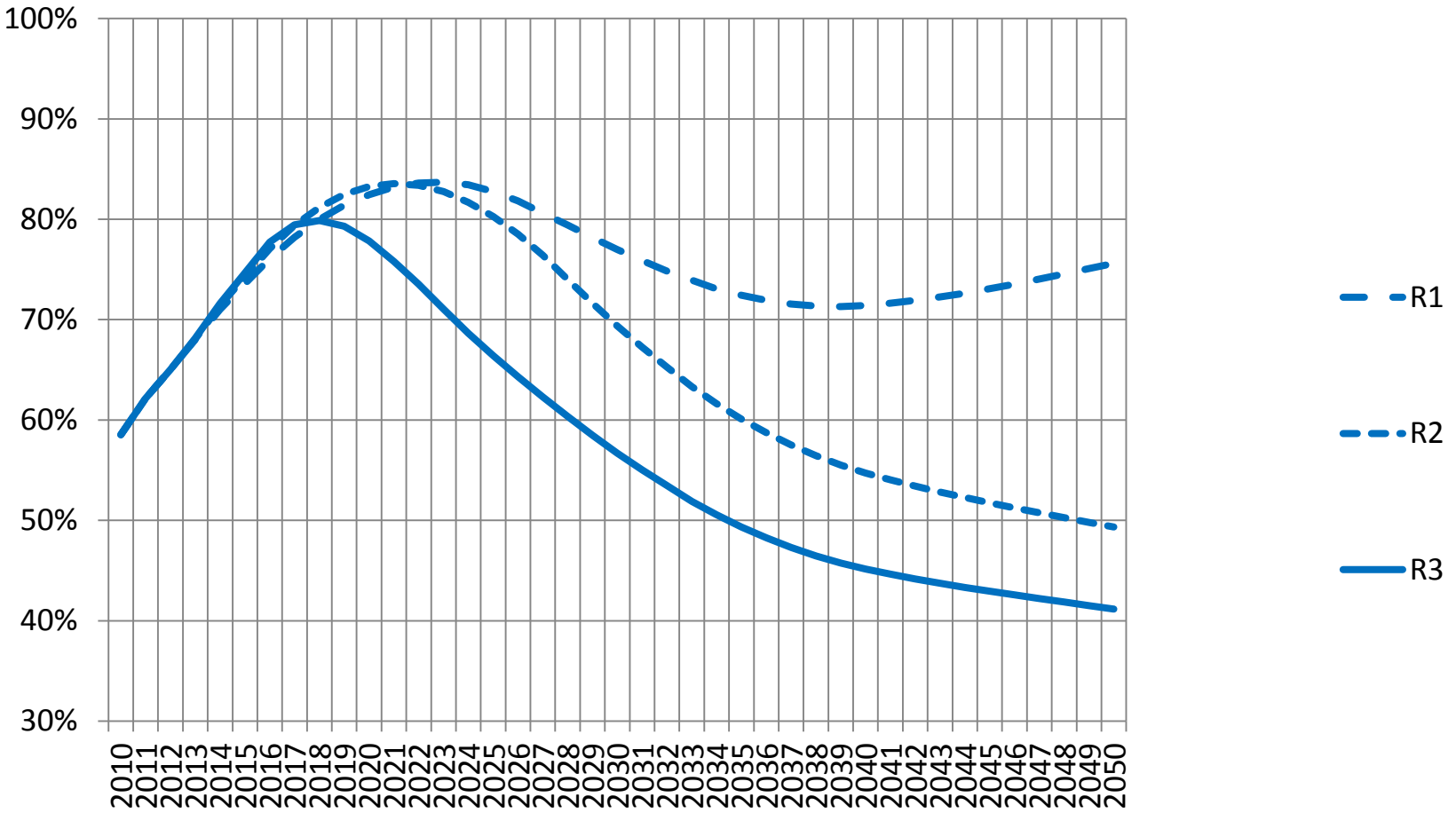


Figure 10. Debt to MaxDebt Ratio with Sustainable Tax Policy



Potential triggers of a crisis

1. Downgrading by credit rating agencies
2. Political shock (failure to pass a tax hike bill, reducing FILP purchase of JGBs)
3. Contagion from foreign countries experiencing sovereign debt crises
4. High energy prices (expectation of future monetary tightening or future inflation)

Downgrading is not likely to be a trigger

- Downgradings by credit rating agencies have been happening already

Table 8. Credit rating history

	Moody's		S&P		Fitch	
		Change to		Change to		Change to
1993	5/3	Aaa				
1998	7/23	Watch (-)				
	11/17	Aa1				
2000	2/17	Watch (-)			6/29	AA+
	9/8	Aa2				
2001	9/6	Watch (-)	2/22	AA+	11/26	AA
	12/4	Aa3	11/27	AA		
2002	2/13	Watch (-)	4/15	AA-	11/21	AA-
	5/31	A2(*)				
2007	7/4	Watch (+)	4/22	AA		
	10/11	A1				
2008	6/30	Aa3				
2009	5/18	Aa2				
2011	8/24	Aa3	1/27	AA-		
2012					5/22	A+
(*) 2-notch downgrade						

Will credit rating "Downgrade" become a trigger for a higher interest rate?

--Not really, at least from the past experiences (See Figures 14-16)

1) Downgrades tend to be followed by lowering of the JGB interest rate

2) However, upgrade lowers the JGB rate more than downgrades

Figure 11. Japan's Sovereign Ratings

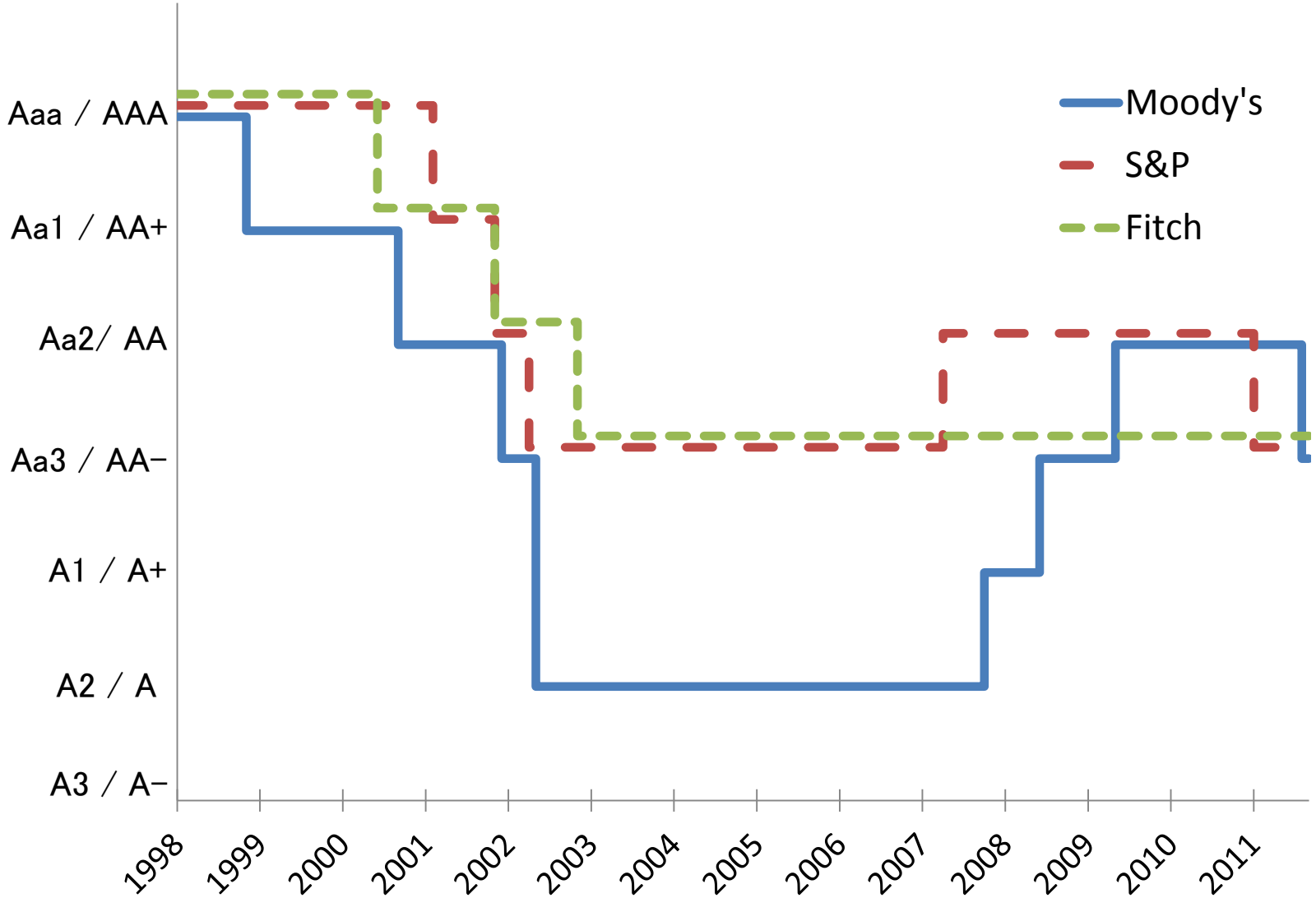
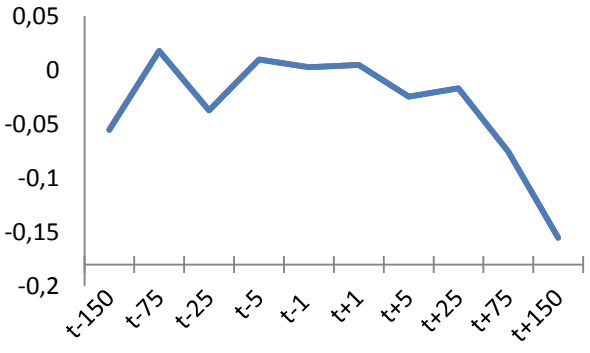
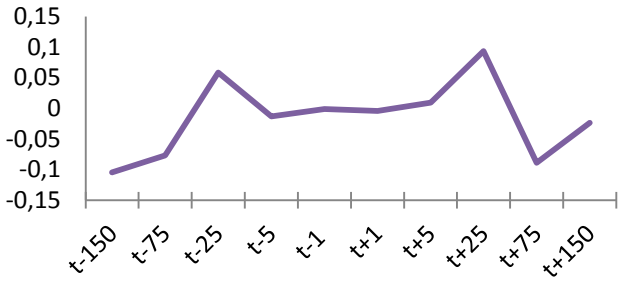


Figure 12. Event Analysis, downgrade on JGB rate

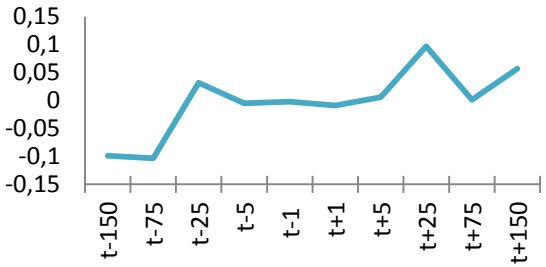
panel 1 JGB interest rate(SP, downgrades)



panel 2 JGB interest rate(Moodys. downgrade and negative watch)

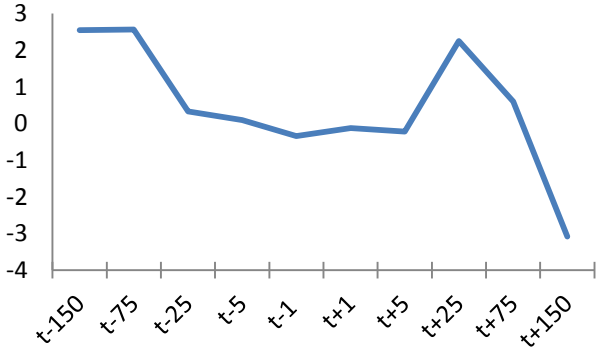


panel 3. JGB interest rate(Moodys, including upgrades)

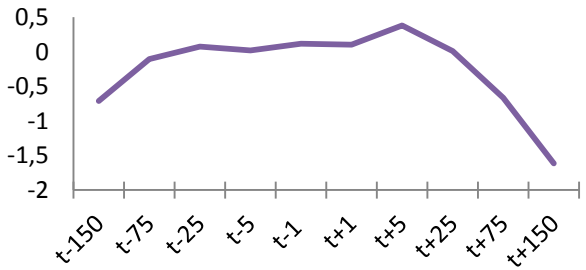


Yen/Dollar rate reaction to downgrade

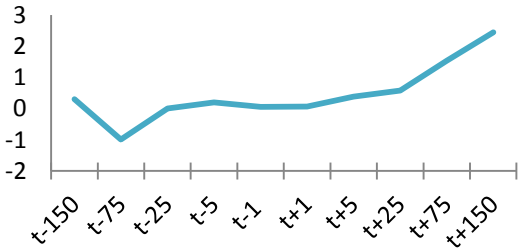
Panel 4. Yen/Dollar rate(SP, downgrades)



Panel 5. Yen/Dollar rate(Moodys, downgrade and negative watch)

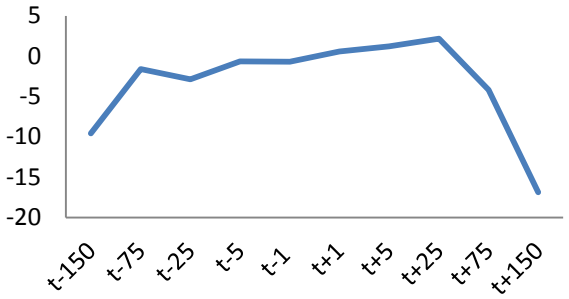


Panel 6. Yen/Dollar rate(Moodys, including upgrades)

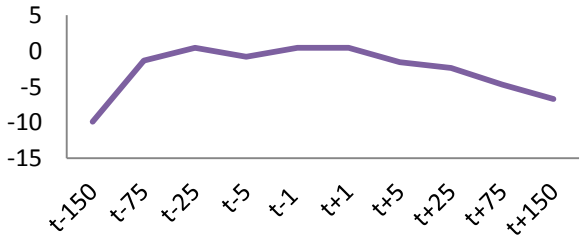


Nikkei 225 reaction to downgrades

Panel 7. Nikkei 225 stock prices(SP, downgrade)



Panel 8. Nikkei 225 stock prices(Moodys, downgrade and negative watch)



Panel 9. Nikkei 225 stock prices(Moodys, including upgrades)

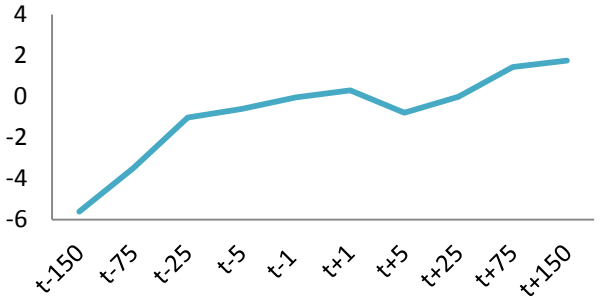
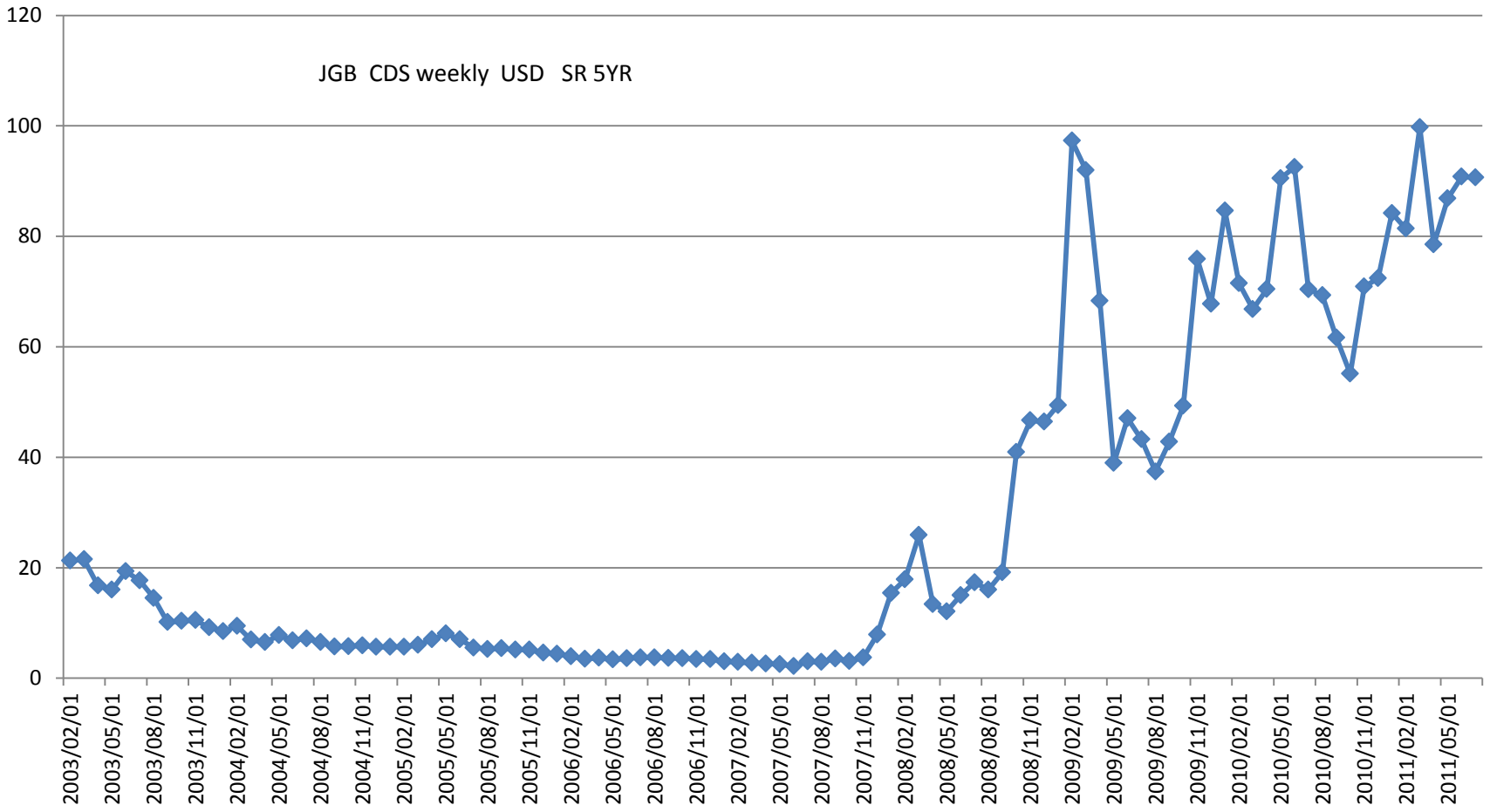


Figure 13. JGB CDS wkly 2003-2011



Earthquake/Tsunami of March 2011

- Total property cost is estimated to be 3% to 5% of GDP
- The government issued Reconstruction Bonds of 11.6 trillion yen (2.4% of GDP) in fiscal 2011 and plans to issue 12.7 trillion yen (2.6% of GDP) in fiscal 2012
  - These additional bond issues have only small impact
- We consider potential delay of tax increase (from 2012 to 2017)
  - The additional delay can have substantial impact
- Cost of nuclear decommissioning is estimated to be substantial. We add 1% of GDP to government expenditure for fiscal 2012, 2013, 2014, 2015
  - Combined with delay, this would be fatal

Figure 14. Debt to MaxDebt ratio with reconstruction expenditures

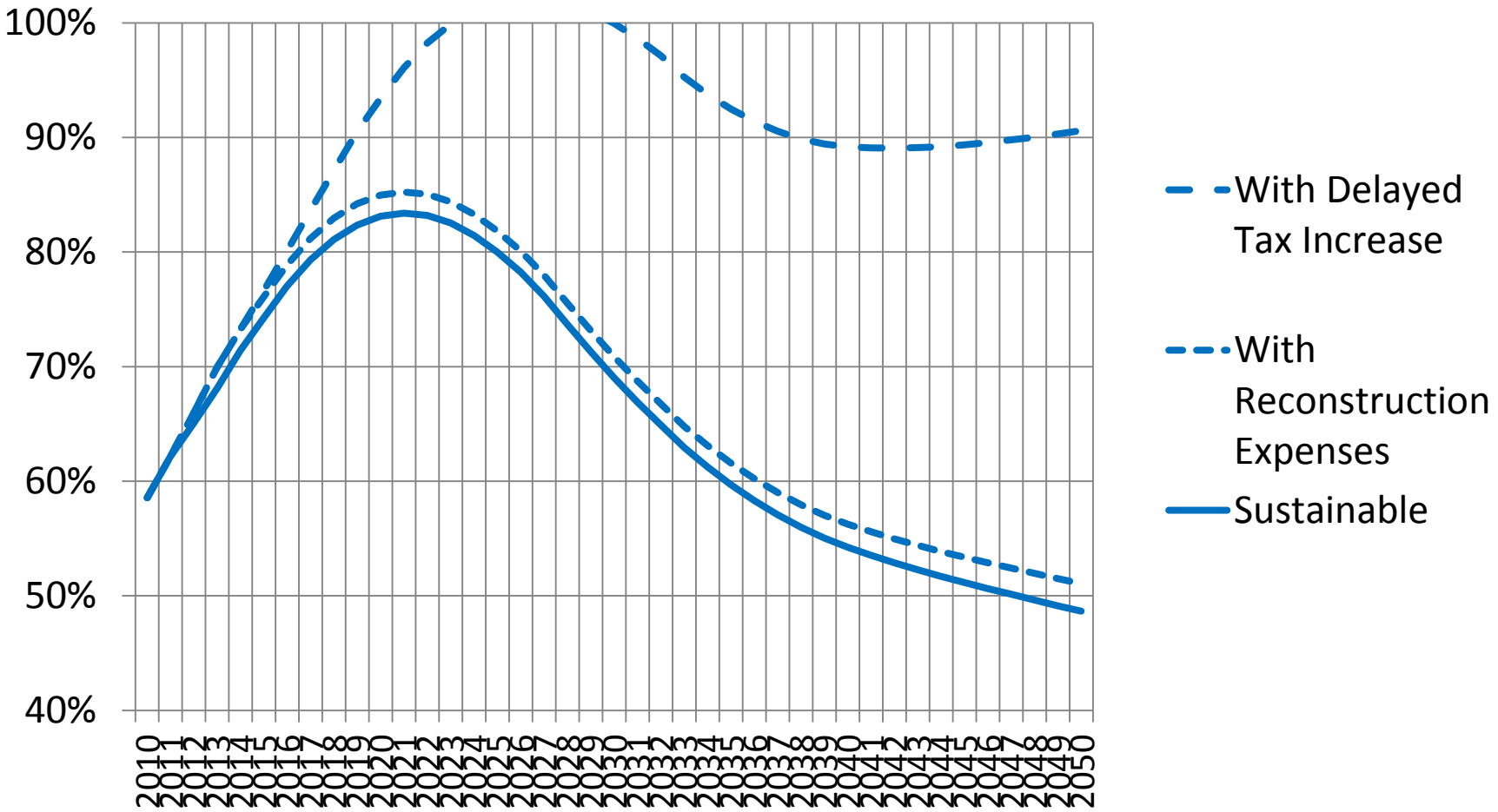
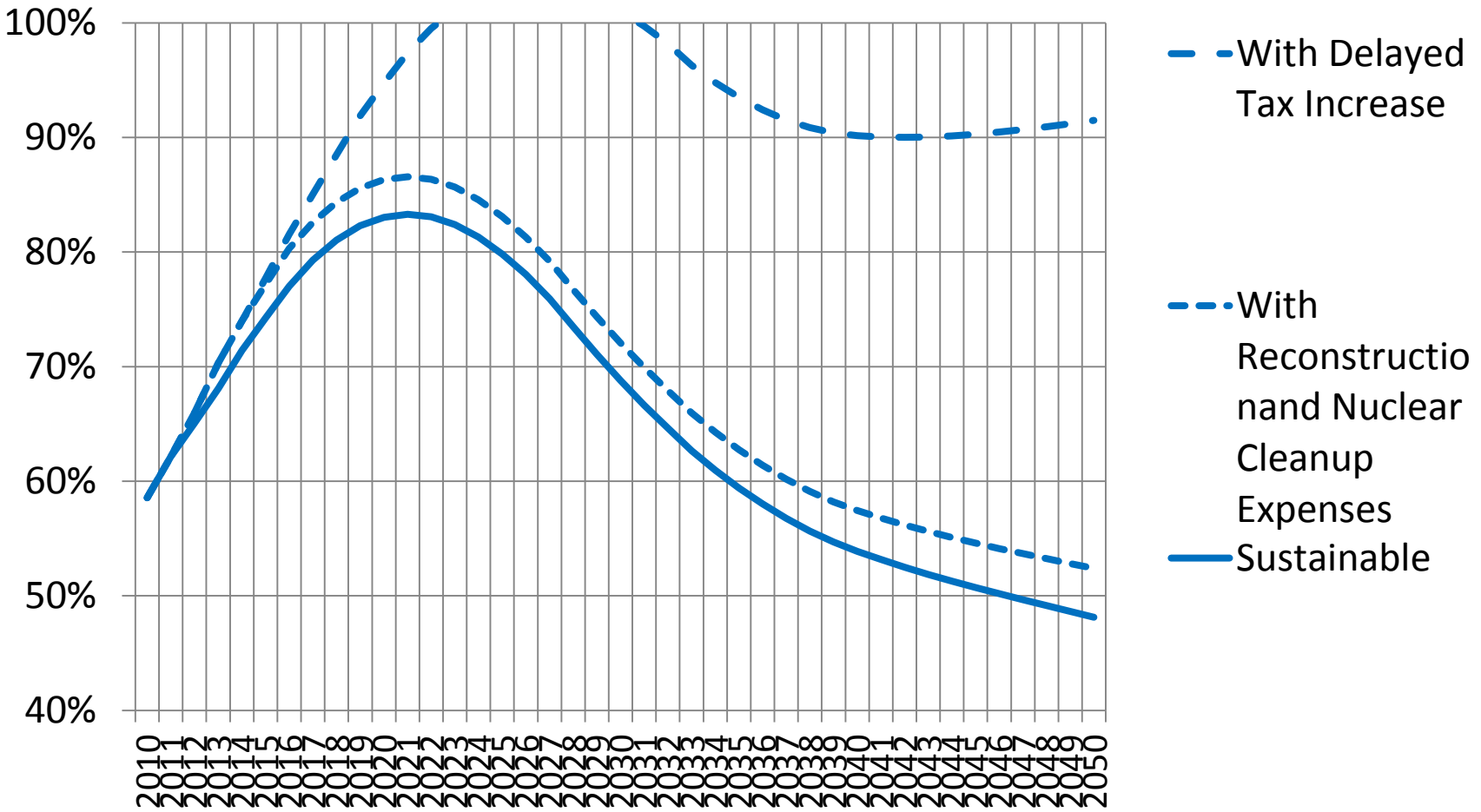


Figure 15. Debt to MaxDebt ratio with reconstruction and nuclear cleanup expenses



Economic consequences of the crisis

1. Rise in JGB yields increases other interest rates → recession → lower tax revenues → worsen the fiscal situation
2. Large capital losses for financial institutions → banking crisis → expectation for government bailouts → worsen the fiscal situation
3. Losses in the government's foreign exchange special account → worsen the fiscal situation
4. The government is forced to respond

Government responses

1. Tax hike during the crisis
2. Expenditure cuts (especially pension benefits) during the crisis
3. Forced rollovers of JGBs held by financial institutions (possibility of banking crisis → worsening fiscal situation)
4. Pressure the BOJ to buy new issues of JGBs → Inflation

Conclusions — recap

1. High debt to GDP ratio with low JGB yields has been supported by:
   - Large private sector domestic savings with home bias
   - And the expectation of future fiscal consolidation before the government debt reaches the ceiling of private sector domestic savings
2. Favorable conditions do not last long as the private saving rate continues do decline as a result of aging
3. A debt crisis will happen when the expectation changes
4. How to finance the reconstruction after the earthquake/tsunami disaster can be critical
5. When the crisis happens, the economy will be impacted, the fiscal situation will be even worsened, and the government will be forced to respond