Budget Balance

Fall semester, 2024

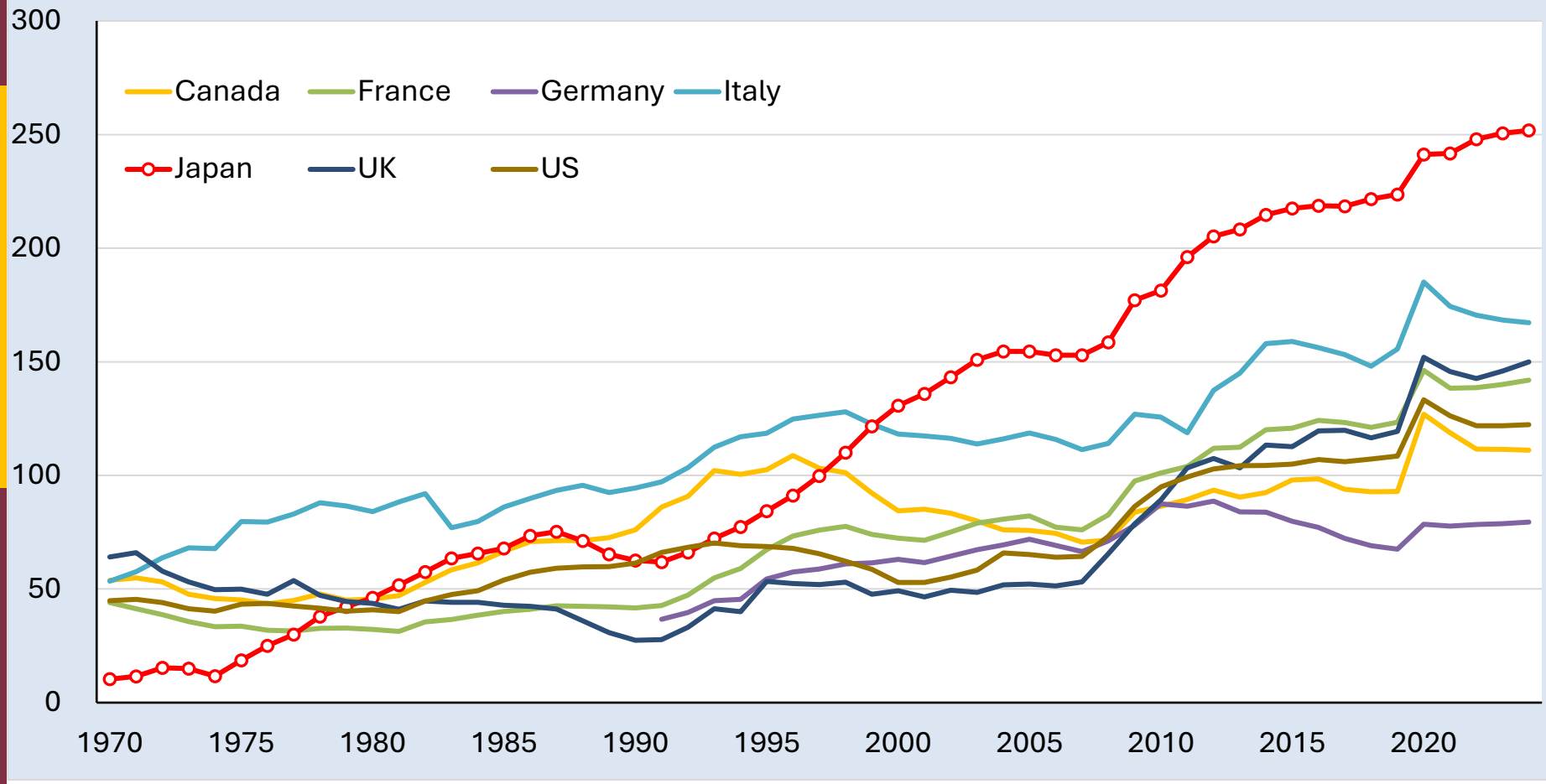
Public Finance

Today's talk

- Statistics on budget deficits and public debt
  - GDP ratios, international comparison
- Budget constraint of government
  - Intertemporal budget constraint, transitional equation
  - How to "repay" public debt
- Fiscal sustainability
  - After debt accumulation
- Simulation analysis on Japan's fiscal situation
  - Accounting, macro-econometric, general equilibrium

Gross financial liabilities

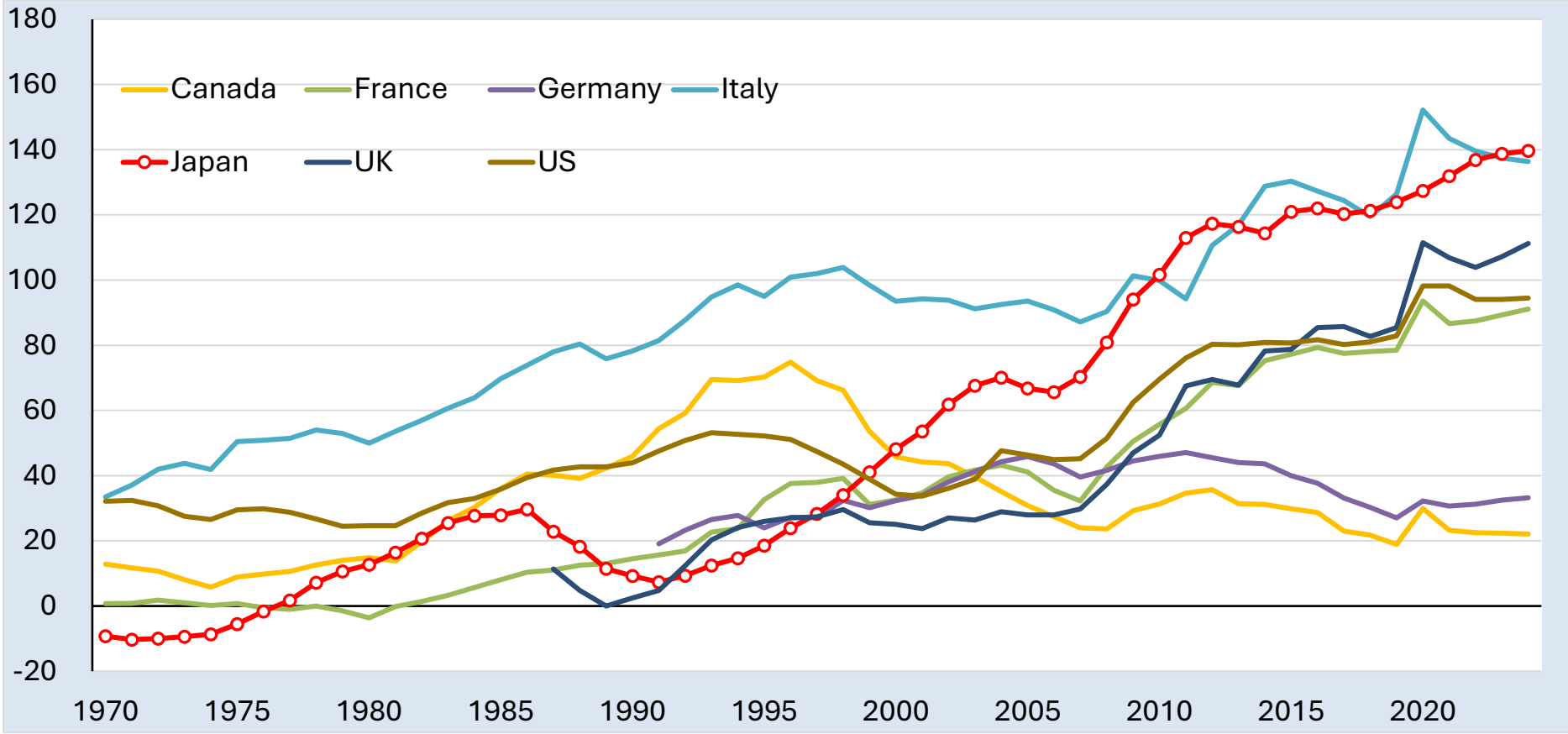
- Japanese government accumulating debt



Source: OECD Economic Outlook 112. https://stats.oecd.org/
General government gross financial liabilities as a percentage of GDP.

Net financial liabilities

- Japanese government accumulating debt
  - Also has social security funds. BOJ holds JGB.



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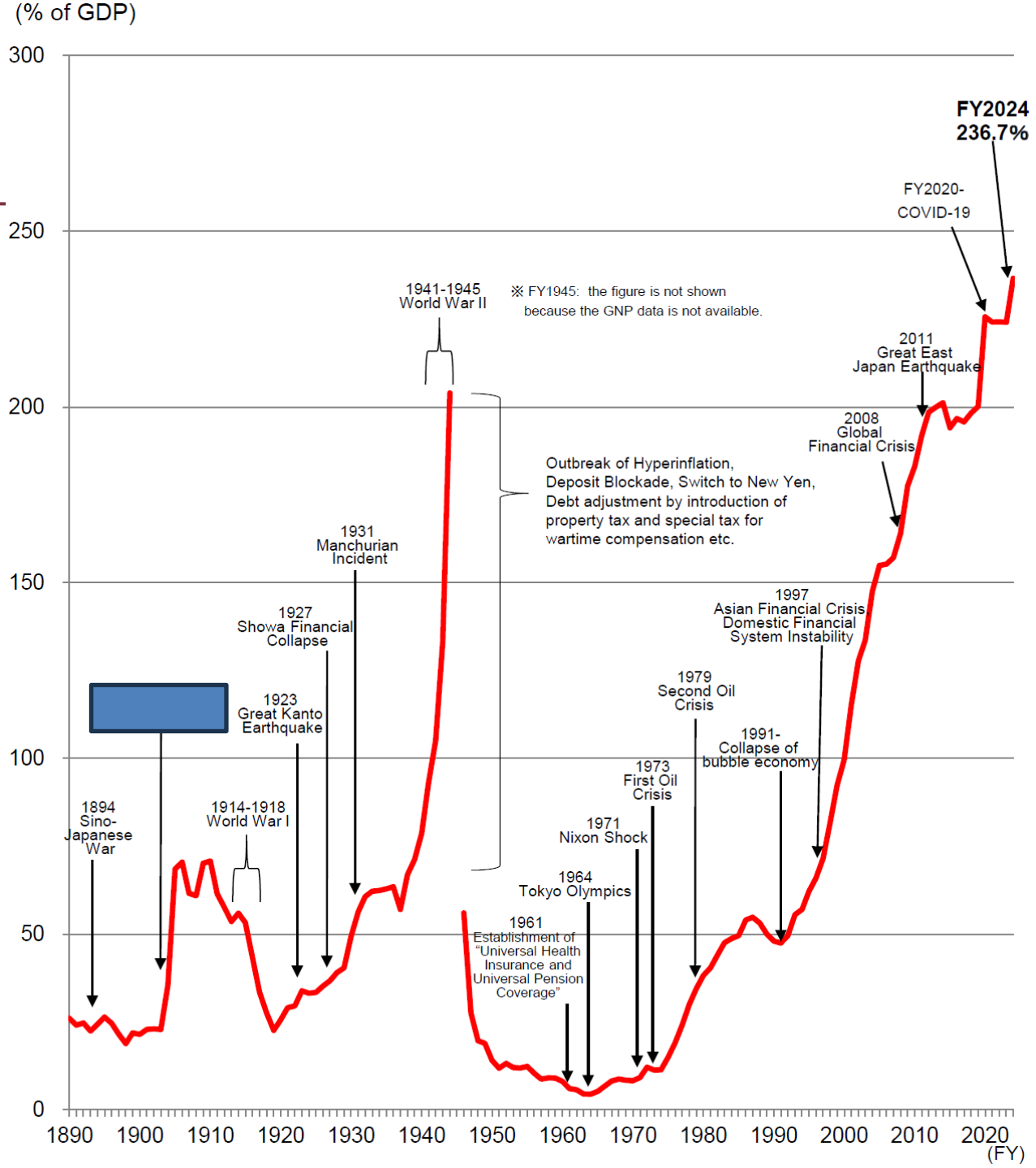
General government net financial liabilities as a percentage of GDP.

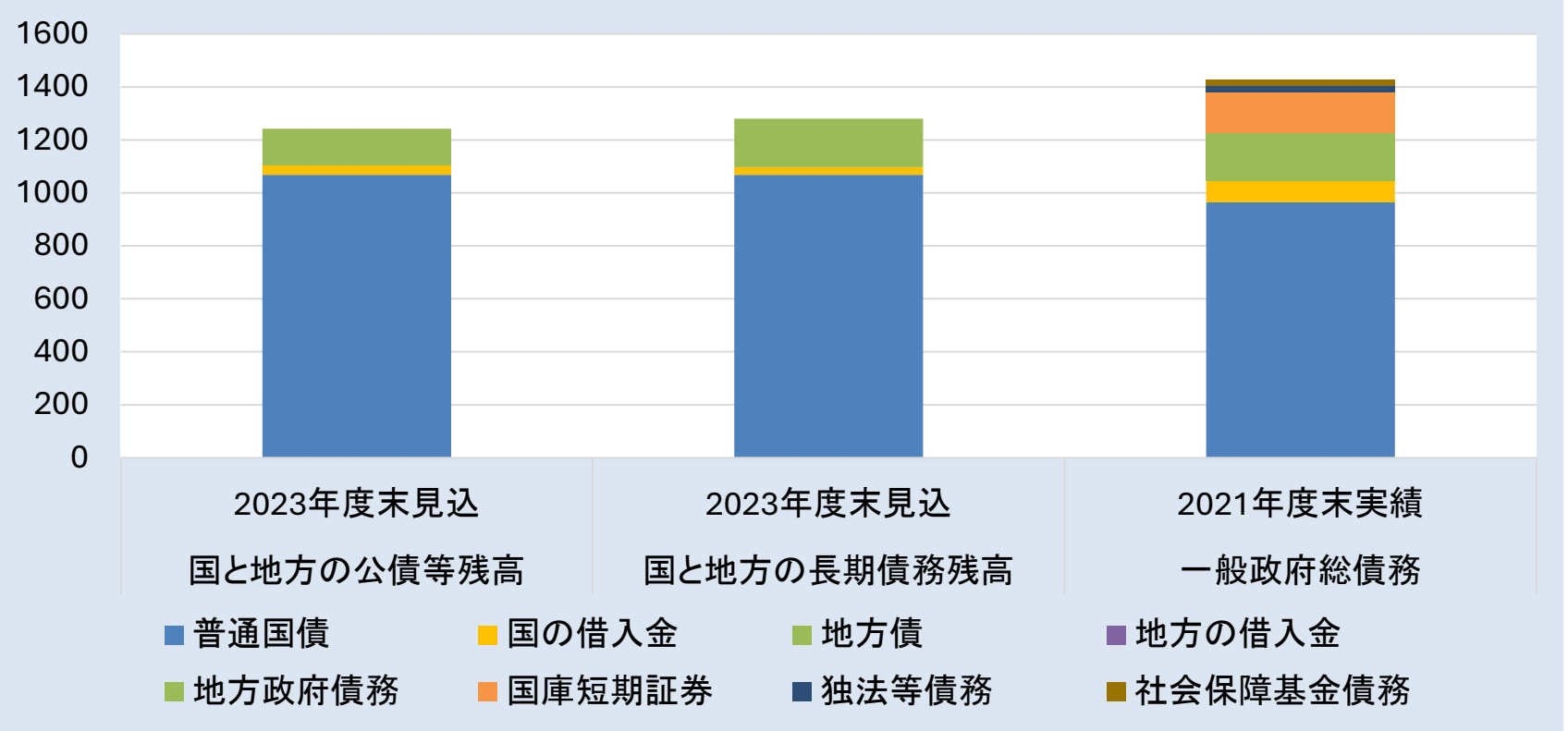
Debt



[Japanese Public Finance Fact Sheet (April, 2024)]

Definitions of public debt

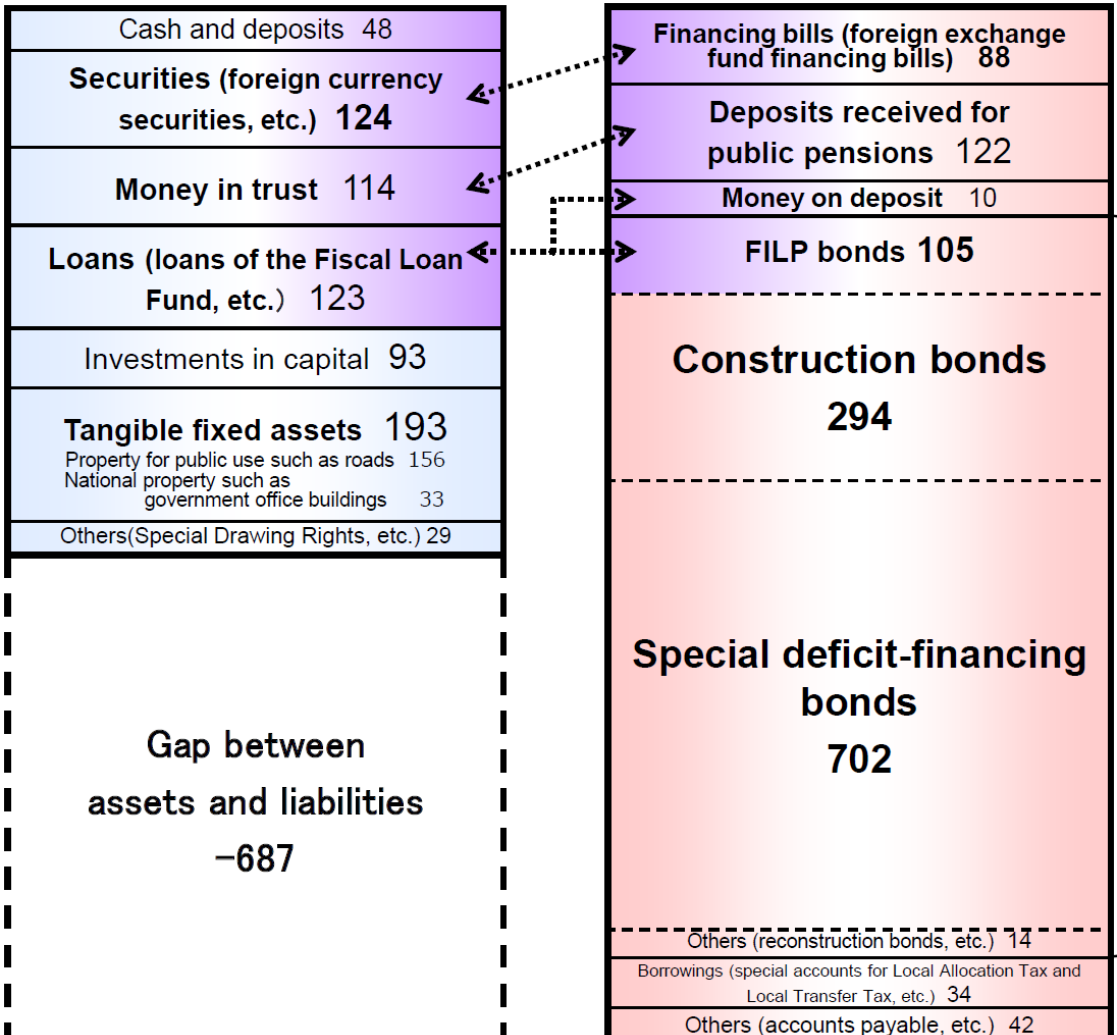
- Public debt in National Accounts (right-hand side)
  - Includes treasury-discount bills, bonds of local public enterprises
  - Excludes FILP bonds



（出所）日本の財政関係資料(令和5年4月)
https://www.mof.go.jp/budget/fiscal_condition/related_data/index.html

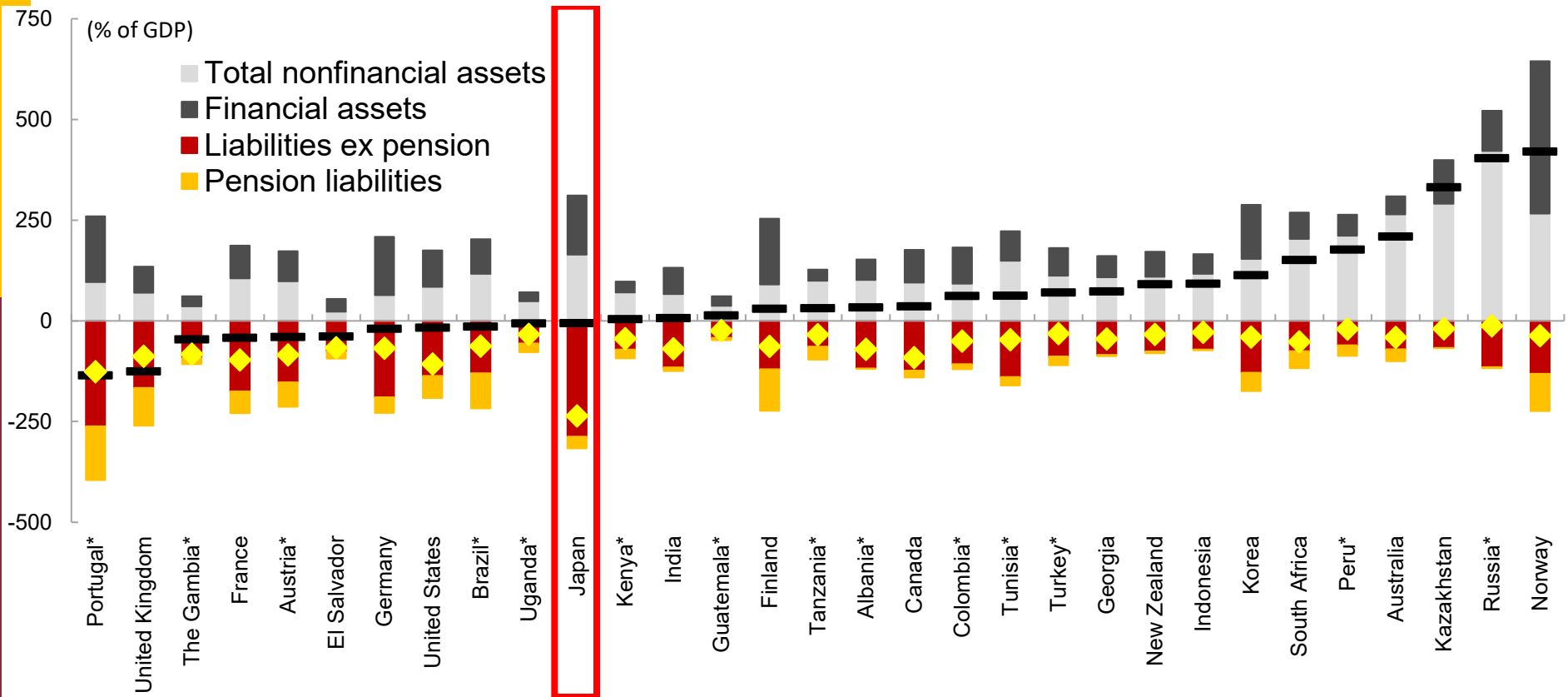
Central govt balance sheet

- National balance sheet (2022)
  - Liabilities: 1411 tri. JPY
  - Assets: 724 tri JPY
- Liabilities
  - Public debts
- Assets
  - Financial
  - Securities: FX intervent
  - Loans: FILP
  - Nonfinancial
    - Roads, rivers
- Therefore
  - Not much to sell



(cf) IMF fiscal monitor 2018

- IMF Fiscal Monitor 2018
  - Net assets of Japanese government is large
    - Huge nonfinancial assets, including roads and bridges



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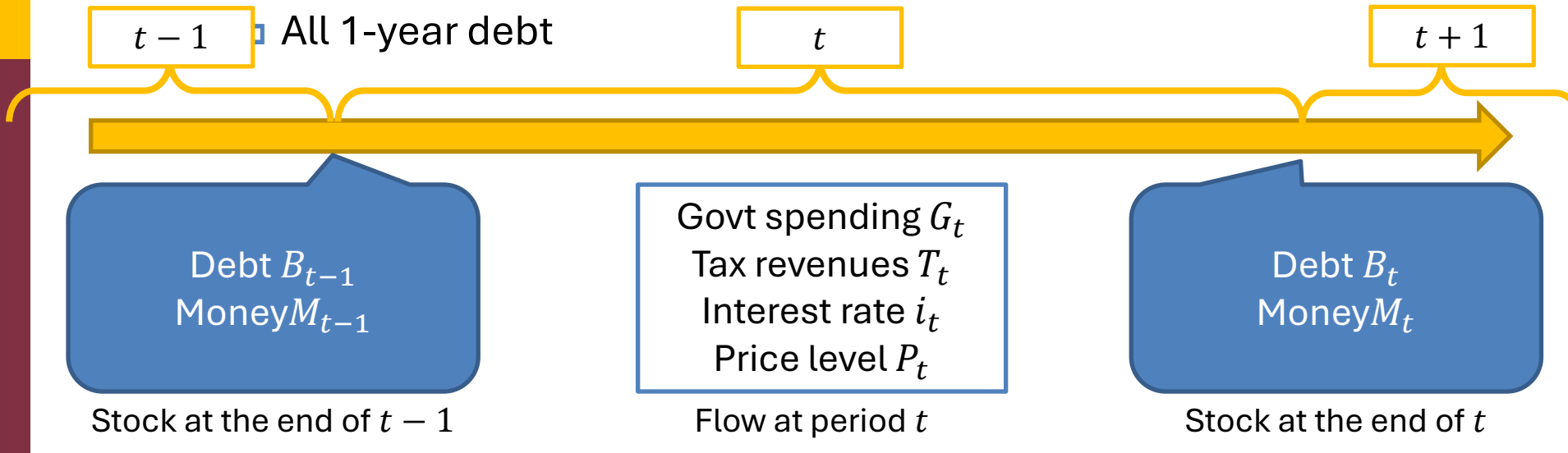
Govt budget constraint (nominal)

- Government's intertemporal budget constraint
  - Considering money, price level
  - Expenditures (excl. debt service) G_t, Tax revenuesT_t, interest rate of period t:i_t, price level P_t
  - At the end of t (beginning of $t+1$): Nominal debt (bond) outstanding B_t, nominal money outstanding M_t
    - Consolidate government: General govt + Central bank
    - Both debt and money are debt to government: BoJ FAQ
    - All 1-year debt



Govt budget constraint (nominal)

- Transition equation of debt: govt budget constraint

$$B_t + M_t = (1 + i_t)B_{t-1} + M_{t-1} + G_t - T_t$$

Primary balance
(Primary budget deficit)

- Divide both side by price level P_t to get real terms

$$\frac{B_t}{P_t} + \frac{M_t}{P_t} = (1 + i_t)\frac{B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t} + \frac{G_t - T_t}{P_t}$$

Real debt outstanding

Real money outstanding

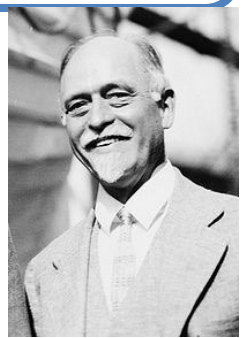
Inflation rate (increase in price level)

$$1 + \pi_t = \frac{P_t}{P_{t-1}}$$

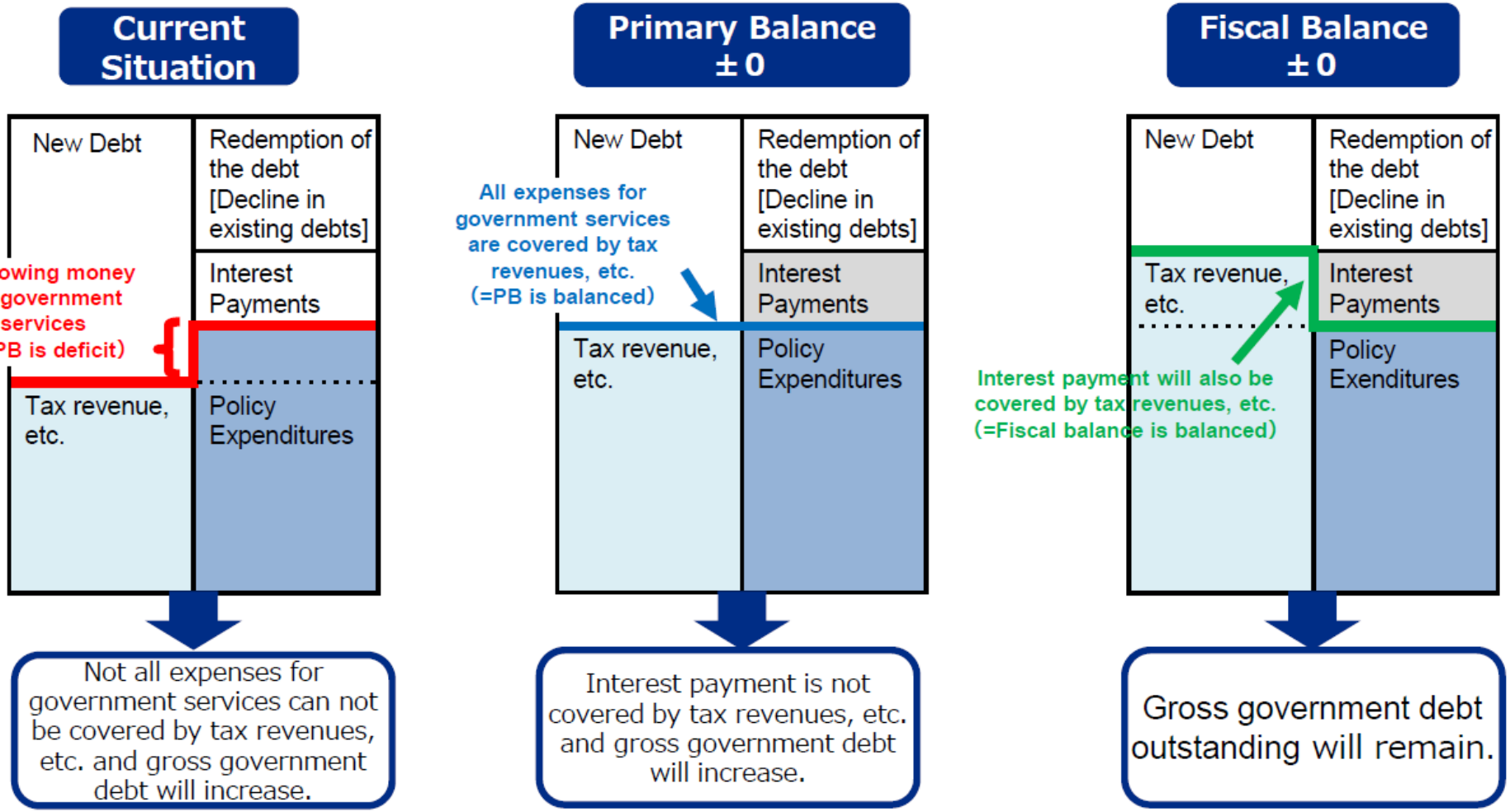
- Fisher equation

$$1 + i_t = (1 + r_t)(1 + \pi_t)$$

Real interest rate



(cf) Budget balance



(source) MOF [“Japanese Public Finance Fact Sheet (April, 2024)”]

Govt budget constraint (real)

- Using Fisher equation,

$$\frac{B_t}{P_t}+\frac{M_t}{P_t}=(1+i_t)\frac{B_{t-1}}{P_t}\frac{P_{t-1}}{P_{t-1}}+\frac{M_{t-1}}{P_t}\frac{P_{t-1}}{P_{t-1}}+\frac{G_t-T_t}{P_t}$$

$$\frac{B_t}{P_t}+\frac{M_t}{P_t}=\frac{1+i_t}{1+\pi_t}\frac{B_{t-1}}{P_{t-1}}+\frac{1}{1+\pi_t}\frac{M_{t-1}}{P_{t-1}}+\frac{G_t-T_t}{P_t}$$

  - Inflation decrease the debt outstanding in real term
    - If nominal interest rate i_t is fixed
  - If interest and inflation rates are small, $i_t = r_t + \pi_t$
  - Decrease in real term = $\pi_t \frac{B_{t-1}}{P_{t-1}}$

Approxi. $r_t\pi_t = 0$

Inflation tax

Transfer of purchasing power
from bond holder to government

Govt budget constraint (expansion)

- Rearranging the budget constraint

$$\frac{B_t}{P_t}+\frac{M_t}{P_t}=(1+r_t)\left(\frac{B_{t-1}}{P_{t-1}}+\frac{M_{t-1}}{P_{t-1}}\right)+\frac{G_t-T_t}{P_t}-\frac{r_t+\pi_t}{1+\pi_t}\frac{M_{t-1}}{P_{t-1}}$$

Seigniorage

  - Seigniorage
    - Government's economic gain from issuing currency
    - Money M_t does not require interest payments
    - Inflation decreases government's debt (increase govt's gain)
    - Inflation tax is from B_t, seigniorage is from M_t

(cf) FTPL (Fiscal Theory of the Price Level)

- Nominal values and inflation do **not** determine real bond outstanding, nominal values (B_t, M_t) determine inflation

Govt budget constraint (expansion)

- Expand the budget constraint to the future
  - Denote seigniorage as S_t

$$\frac{B_{t-1}+M_{t-1}}{P_{t-1}} = \frac{1}{1+r_t}\frac{T_t-G_t}{P_t} + \frac{S_t}{1+r_t} + \frac{1}{1+r_t}\frac{B_t+M_t}{P_t}$$

$$= \frac{1}{1+r_t}\frac{T_t-G_t}{P_t} + \frac{S_t}{1+r_t} + \frac{1}{1+r_t}\frac{1}{1+r_{t+1}}\left(\frac{T_{t+1}-G_{t+1}}{P_{t+1}} + S_{t+1} + \frac{B_{t+1}+M_{t+1}}{P_{t+1}}\right)$$

Sum of discounted prevent value of primary surplus at t and t+1

Sum of discounted prevent value of seigniorage at t and t+1

$$= \frac{1}{1+r_t}\frac{T_t-G_t}{P_t} + \frac{1}{(1+r_t)(1+r_{t+1})}\frac{T_{t+1}-G_{t+1}}{P_{t+1}} + \frac{S_t}{1+r_t} + \frac{1}{(1+r_t)(1+r_{t+1})}\frac{S_t}{1+r_{t+1}}$$

$$+ \frac{1}{(1+r_t)(1+r_{t+1})}\frac{B_{t+1}+M_{t+1}}{P_{t+1}}$$

Debt outstanding at the end of t+1

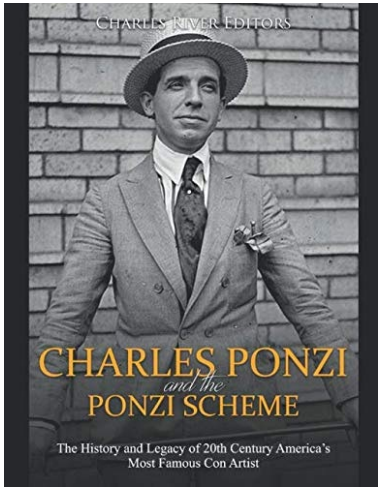
Govt budget constraint

- Repeat the expansion further to the future

No Ponzi Game condition

- If the present value of debt outstanding far in the remote future is zero,

Current sum of debt and money outstanding	=	Sum of discounted present value of primary surplus in the future	+	Sum of discounted present value of seigniorage in the future



How to repay public debt

- Primary surplus
  - Increase in tax or decrease in expenditure
  - Tax increase: Bad effects on those who pay taxes
  - Expenditure decrease: Bad effects of decrease in public services / transfers
- Inflation tax, seigniorage
  - Depreciation of the currency: Burden on currency / public debt holders
- Default
  - Burden on public debt holders (100% tax on debt)
  - Debt restructuring: revision of terms
- All have side effects
  - Economic downturn, high inflation, decline in public credit

Hyperinflation

- Hyperinflation
  - One definition: monthly rate 50%+ (yearly 130x)
- Interwar period
  - Hungary (1922-24), Austria (1922-23), Poland (1921-24)
  - Germany (1922-23)
- 1988-92: Argentina
- 2007-09: Zimbabwe
  - Annual rate in Jan 2009 was 6.5×10^{108} %
- 2018-19: Venezuela
  - https://www.bbc.com/worklife/article/20180918-the-people-making-bags-out-of-worthless-money

100 trillion Zimbabwe dollar (wikipedia)

https://www.aljazeera.com/economy/2019/12/24/venezuelas-currency-worth-more-as-craft-paper-than-as-money

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Fiscal sustainability

- What if government rely only on primary surplus?
  - If seigniorage is small and default is not an option
- Budget constraint ignoring money:

$$B_t = (1 + i_t)B_{t-1} + G_t - T_t$$

  - Divide both side by output Y_t to obtain GDP ratio

$$\frac{B_t}{Y_t} = (1 + i_t)\frac{B_{t-1}}{Y_t} + \frac{G_t - T_t}{Y_t}$$

  - Denote the growth rate as $1 + g_t = Y_t/Y_{t-1}$

$$\frac{B_t}{Y_t} = \frac{1 + i_t}{1 + g_t}\frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t}$$

  - If primary balance is zero, $G_t - T_t$,

    Interest rate > growth rate, $i_t > g_t$, bond/GDP increase

    Interest rate < growth rate, $i_t < g_t$, bond/GDP decrease

Fiscal sustainability

- Domer Condition
  - If primary balance = 0,
    - $i_t > g_t$, bond/GDP increase
    - $i_t < g_t$, bond/GDP decrease = sustainable
  - Usually, r > g (Thomas Piketty)
    - In 2010s, r < g: Blanchard (2019, AER)

- Test of fiscal sustainability: Time-series analysis
  - Test r > g
  - Bohn test: when debt increase, primary surplus increase?
  - and etc.
  - Negative results for Japan

Debt accumulation, then…?

- Reinhart and Rogoff “This Time Is Different”
  - Fiscal collapse is not so rare
- After debt accumulate…
  - (Economic growth)
  - (Primary surplus)
  - Default or debt restructuring
  - Sudden inflation
  - Financial depression: Govt forces private sectors to buy govt bond by low interest rates
- When gross debt of central govt exceeds 60% of GDP,
  - 63 cases (35 countries) in Reinhart’s database
  - 37 cases went financial collapse

出所

Public debt in Japan

- How has Japan's govt coped with public debt?
  - Decomposition: economic growth, primary balance, inflation
  - https://www.rieti.go.jp/jp/columns/a01_0379.html
  - Only after Japan-Rosso war, primary surplus worked

表1 債務GDP比率の変動の要因分解

表の数値はサンプル期間内の平均値である。プライマリー収支の数値についてはプラスが赤字を，マイナスが黒字を表す。

	Total	Fiscal balance			Nominal growth		
	[2] + [5]	[3] + [4]	Primary	Interest	[6] + [7]	Real	Inflation
期間	[1]	[2]	[3]	[4]	[5]	[6]	[7]
1886-1905	1.1%	2.6%	1.7%	0.9%	-1.5%	-0.6%	-0.8%
1906-1916	-4.1%	-1.2%	-3.2%	2.0%	-2.9%	-1.3%	-1.7%
1917-1944	4.5%	8.5%	6.8%	1.8%	-4.0%	-0.9%	-3.1%
1945-1948	-46.3%	2.7%	2.0%	0.7%	-49.1%	6.2%	-55.2%
1949-1986	0.6%	2.1%	1.0%	1.1%	-1.5%	-0.9%	-0.6%
1987-1990	-2.0%	1.0%	-2.2%	3.2%	-3.0%	-2.4%	-0.5%
1991-2005	6.0%	6.3%	3.8%	2.5%	-0.3%	-0.9%	0.6%
2006	-0.1%	0.8%	-1.0%	1.8%	-0.9%	-2.1%	1.2%
2007-2011	7.6%	5.7%	3.7%	2.0%	2.0%	0.0%	1.9%

(cf) History of government debt

- Eichengreen et al. “In Defense of Public Debt”
  - Ancient Greek city-state
  - Monarch borrowing restarted in 10th century
    - King Edward III borrowed from Italian bankers during the Hundred Years War (1337-1453)
      - 1-2 years, double-digit interest rates
      - Defaulted as early as 1345
    - Sometimes granted authority of tax collection as collateral
  - Difficult under absolute monarchy
    - King Felipe II of Spain defaulted four times
  - The Glorious Revolution: Parliamentary control lowered interest rates
  - King William III established the Bank of England
    - Money demand during the Nine Years War (1688-1697)
    - Loans in exchange for currency issuance rights

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Simulation analysis

- Accounting method, Partial equilibrium analysis
  - Exogenously given economic growth, interest rate, population size
  - Govt expenditures and revenues are functions of these variables
  - No feedback from economy to fiscal situation
  - Mid- and long-term forecast by Cabinet Office of Japan
  - European Commission: Debt Sustainability Monitor (2023)
    - Not applicable to Japan
  - Broda and Weinstein (2005) https://www.nber.org/papers/w10988
    - To keep net public debt-GDP ratio as 60%, govt revenue-GDP ratio had to increase to 35%, same as in 1990
      - Not so different with European countries at that time
    - “Happy news from dismal science”
    - Replication: Doi, Hoshi and Okimoto (2011, JJIE)

Simulation analysis

- Macro-econometric model
  - System of equation of macroeconomic variables
  - Change fiscal variables (exogenously given) to see the effects
  - Feedbacks from economy to fiscal situation
    - Large system can incorporate detailed fiscal institution
    - Mid-term analysis in government
  - Not sufficient microeconomic foundation

Simulation analysis

- General equilibrium model: Representative agents / OLG
  - Setting “deep” parameters of utility and production functions
    - “Calibration”
  - Microeconomic foundation
    - Macroeconomic variables (e.g., consumption, saving) are determined as solutions of optimization problem of households and firms
  - Computer intensive. Not very detailed
    - Hard to incorporate the details of institutions
    - Assume a steady state in the long-run: Govt budget constraint is assumed to be satisfied
  - Hansen and Imrohoroglu (2017), Kitao (2018, JER), Kitao and Mikoshiba (2020, JJIE)
    - Higher than 30% VAT is necessary

Simulation analysis

- OLG general equilibrium model: Hybrid
  - Not solve the households' optimization problem
    - Estimate functions of consumption, labor supply, …
    - Exogenous interest and wage rates
  - Instead…
    - Household heterogeneity: ability, gender, …
    - Institutional details: tax, social security, …
  - Calculate the effects of policy changes
- Examples:
  - Storesletten (2003, Scand. J.E)
  - Imrohoroglu, Kitao, Yamada (2016, IER)
  - Imrohoroglu, Kitao, Yamada (2019, J E Ageing),VoxEU
    - Policy combinations improve the fiscal situation: increase pensionable age, cut down pension benefit, increase copayments, raise VAT rate, promote female labor participation…