Debt Sustainability in Japan: Macroeconomic and Asset Pricing Perspectives

Jorge A. Chan-Lau and Aruhan Rui Shi*

December 2025

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Abstract

Debt sustainability has become a major concern in advanced economies as they grapple with rising public debt levels, challenging monetary policies, and shifting investor expectations. This paper examines Japan's fiscal position from the perspectives of the standard debt sustainability analysis and the asset pricing approaches. The findings suggest that several factors contribute to mitigate debt sustainability risks. Moreover, under favorable conditions, the present value of government debt is consistent with its current market valuation, as it accounts for the country's capacity to repay its debt relying on future primary surpluses and a reduction of its debt stock. However, as the Bank of Japan normalizes monetary policy and scales back from large-scale bond purchases, the sustainability of Japan's debt may come under increasing pressure. These findings underscore the importance of proactive fiscal adjustments to steer the economy towards long-term fiscal stability and enhanced resilience against financial shocks.

Keywords: Japan, debt sustainability, asset pricing, primary surpluses

JEL codes: H30, H63, H68

*ASEAN+3 Macroeconomic Research Office, 10 Shenton Way 15-08 MAS Building, Singapore 079117. A previous version of this paper was circulated as AMRO working paper no.25-05. We thank Seung Hyun (Luke) Hong for his insightful feedback, and Paolo Hernando, Byunghoon Nam, and Runchana Pongsaparn for their helpful comments and suggestions. We are responsible for any errors or omissions. Please address correspondence to both authors. Email addresses: Chan-Lau jchanlau@gmail.com (permanent) and jorge.chan-lau@amro-asia.org; Shi aruhanruishi@outlook.com (permanent) and aruhan.rui.shi@amro-asia.org.

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1 Introduction

Global public debt is projected to surpass USD111 trillion or 95 percent of global GDP by 2025, with no end in sight to its rising trend. Two out of three countries, however, have managed to stabilize their public debts. Despite this progress, various challenges threaten debt sustainability, including political uncertainty, difficulties in reining in public expenditures, potential underestimation of debt projections, overly optimistic forecasts of primary surpluses, and rising borrowing costs as policy rates rise in the post-Covid period. High debt levels pose serious economic problems. They reduce fiscal space and limit governments' ability to respond to economic downturns. They also crowd out essential growth-enhancing investments and raises the risk of sovereign distress (Brunnermeier et al. 2016, Farhi and Tirole 2018), which, if compounded with prolonged debt accumulation, increases the likelihood of debt distress and could trigger a broader financial crisis. Accordingly, a smooth transition to fiscal normality requires rebuilding fiscal buffers and reforming fiscal policies to ensure debt sustainability (IMF 2024b).

In this context, assessing the fiscal soundness of sovereign states is crucial for identifying current strengths and weaknesses, and by addressing the latter, maintaining economic stability and fostering long-term growth. By fiscal soundness we refer to a government's ability to manage public finances sustainably, to minimize sovereign default risk, and to maintain the needed flexibility to respond to economic shocks. A robust fiscal position enables countries to engage in development initiatives, social programs, and public investments without increasing financial vulnerabilities. Conversely, countries that fail to maintain fiscal soundness face higher borrowing costs, restricted access to international financial markets, and a heightened risk of economic crises.

Debt sustainability is a critical concern not only for developing and emerging market economies but also for advanced economies. Until recently, debt sustainability analysis (DSA) was mainly conducted for developing and emerging market economies given the fact that they had experienced numerous fiscal crises in the past (Medas et al. 2018). Such state of affairs was supported by several studies that suggested institutional features in these economies caused them to be more debt-intolerant than advanced economies, with the latter able to sustain higher levels of public debt (Reinhart, Rogoff, and Savastano 2003, Reinhart and Rogoff 2010). However, the European sovereign debt crisis in the 2010s, which threatened the viability of the European Monetary Union, underscored that public debt sustainability in advanced economies cannot be taken for granted. Moreover, as the era of low interest rates come to an end, the high debt ratios in advanced economies could render them more vulnerable to a financial crises than their developing and emerging market counterparts.

Among advanced economies, Japan has the highest general government gross debt-to-GDP ratio in the world, projected by the IMF to reach 241 percent of GDP in 2024. Several factors

mitigate fiscal risks, such as the debt being denominated in Japanese yen and primarily held domestically, and the government's large asset holdings. However, the country is under significant fiscal pressure due to the need to fund support for an aging population and the green transition, all while grappling with sluggish economic growth. Additionally, the rise in interest rates following the economy's exit from deflation would increase future debt servicing costs. Furthermore, as the Bank of Japan (BOJ) gradually scales back its purchases of Japanese government bonds and shifts the purchases back to the market, the market's evaluation of Japan's fiscal position is becoming increasingly important. This situation underscores the importance of analyzing Japan's fiscal position, which could offer valuable lessons for policymakers striving to balance economic growth with debt sustainability in a rapidly changing global landscape. Furthermore, Japan's experience can serve as a case study for other advanced economies grappling with rising public debt and fiscal risks. Maintaining Japan's fiscal stability is not only a national priority but also a matter of global importance, as fiscal instability in Japan could have far-reaching consequences for global financial markets.

This paper examines the soundness of Japan's fiscal position from two complementary perspectives. The first is the standard macroeconomic-based debt sustainability methodology, a cornerstone of the IMF's policy advice (IMF 2022). The second perspective employs the asset pricing-based fiscal capacity methodology introduced by Jiang et al. (2023, 2024), which uses risk-based valuation measures to assess whether the market prices of sovereign debt align with a country's repayment capacity. Additionally, this approach examines whether the government's fiscal projections can justify current debt levels, and whether the market valuation of the government debt is consistent with the country's capacity to repay its debt. By combining these two approaches, this analysis aims to provide a more comprehensive understanding of Japan's fiscal position and identify potential vulnerabilities more effectively.

Our analysis reveals two key findings. First, using market discount rates and assuming that only primary surpluses are used to service debt, Japan's high debt implies that substantial future primary surpluses and additional borrowing will be needed to justify its current market valuation. This is especially concerning amid rising interest rates. This result is in line with those of the DSAs conducted by multilateral institutions, which, despite recognizing mitigating factors like long debt maturities and a stable domestic investor base, concluded that managing the risks due to elevated debt levels required the government to undertake gradual fiscal consolidation to rebuild buffers and to reduce the pressures from higher interest rates, healthcare costs, and long-term care for an aging population (IMF 2024a, AMRO 2024).

Our second key finding is that Japan's fiscal position appears stronger when assumptions shift from the conservative baseline toward more sanguine projections . Under the optimistic fiscal scenario—characterized by faster growth and improved primary balances—and once the BOJ's nearly 50 percent share of JGB holdings is taken into account, the valuation gap narrows

substantially. The market value of government debt aligns closely with the discounted value of contractual cash flows, suggesting that investors appear to be confidence in Japan's ability to meet its obligations. This confidence likely reflects two implicit beliefs: first, that JGBs held by the BOJ do not impose the same redemption pressures as privately held debt; and second, that fiscal outcomes may ultimately resemble the optimistic scenario rather than the baseline.[1] Together, these factors indicate that current market stability is heavily dependent on investor perceptions and the BOJ's balance-sheet support, rather than long-run fiscal fundamentals.

The remainder of this paper is organized as follows. Section 2 explains the macroeconomic and financial perspectives on debt sustainability, highlighting its similarities and their conceptual differences. Section 3 reviews some of the literature on debt sustainability in Japan. Section 4 analyzes debt sustainability in Japan using the standard and asset pricing approaches. This section also discusses the results, followed by the conclusions presented in Section 5.

2 Debt sustainability: the macroeconomic and financial perspectives[2]

2.1 The macroeconomic perspective

The main goal of sovereign risk assessment is to determine whether the government is solvent or not. In the macroeconomic literature, several sustainability assessment approaches have been developed. The main ones are based either on the simulation of medium-term and long-term public debt dynamics, the construction of structural models such as dynamic stochastic general equilibrium models in which governments always pay their debts when they have the available resources, or models of strategic behavior, where governments may choose to default despite having the ability to continue servicing their debt (D'Erasmo, Mendoza, and Zhang 2016).

Policy making institutions favor the debt dynamics approach, which has been integrated in their DSA methodologies, as is the case at the European Central Bank (Bouabdallah et al. 2017) and the International Monetary Fund (IMF 2022).[3] This approach builds upon the intertemporal government budget constraint (IGBC). Satisfying the constraint requires that the value of the outstanding public debt, should be equal to the future primary fiscal balances, $pb_{t+h},\ h = 0, 1, \ldots$, multiplied by the discount factors, $M_{t,t+h},\ h = 1, 2, \ldots$, which yields the following equation:

1. The optimistic growth scenario and the baseline scenario are derived from Cabinet Office (August 2025), specifically the "transitioning to a new economic stage" and "past trend projection" cases, respectively.

2. This section draws extensively on D'Erasmo, Mendoza, and Zhang (2016), Willems and Zettelmeyer (2022), and Jiang et al. (2023).

3. The DSA frameworks of these institutions also include other tools beyond those based on debt dynamics. For instance, the IMF complements the debt dynamics analysis with near-term sovereign stress indicators, an evaluation of gross financing needs, and long-term scenario analysis of the impact of climate change, demographics and resource depletion.

$$b_{t-1} = pb_t + \sum_{h=1}^{\infty} M_{t,t+h}\, pb_{t+h}. \tag{1}$$

It follows naturally that a violation of the IGBC indicates that the debt is unsustainable since it exceeds the discounted value of present and future primary surpluses. Equation (1) can be extended to deal with the particular characteristics of a country's sovereign debt profile. For example, the IMF DSA methodology allows for public debt denominated in foreign and domestic currencies and factors in the effect of the exchange rate as well as domestic and foreign inflation. The dynamics of the debt to GDP ratio, Δd_t, are determined by:

$$\Delta d_t = \frac{z_t d^f_{t-1}}{(1+g_t)(1+\pi^f_t)} + \frac{r_t - g_t}{1+g_t} d_{t-1} + \frac{\pi^d_t - \pi^f_t}{(1+\pi^f_t)\rho_t} d^f_{t-1} - pb_t + sfa_t \tag{2}$$

where z is the real exchange rate, g is real GDP growth, r is the domestic real effective interest rate, d^f are the debt to GDP ratio held in foreign currency, $\pi^i, i = d, f$ are the domestic and foreign inflation rates, ρ is the nominal GDP growth rate, and sfa are stock flow adjustments due to other effects (Escolano 2010, IMF 2022).

Macroeconomists and fiscal policy practitioners do not recommend using equation (1) directly. The rationale for the recommendation is that any high debt level as well as any long sequence of primary budget deficits are sustainable as long as the country can run high surpluses for a long period of time afterwards, which might not be a credible policy. Instead, they suggest using the debt dynamics equation to simulate the debt path over a given time horizon, typically in the 5 to 10 years range. In the simulation, the relevant variables in the debt dynamics equation are subject to random shocks consistent either with the country's historical experience or with those implied by an econometric or statistical model. The replications in the simulation generate a distribution of potential debt paths. When the baseline path projected by the economic analysts is compared to the distribution, its relative position suggests whether the debt position would improve or deteriorate.

In addition, framing the sustainability analysis in the context of the debt dynamics serves to identify a debt stabilizing primary balance, which corresponds to a steady state equilibrium in which the debt to GDP ratio remains unchanged, which is consistent with the view that fiscal policy is sustainable if the debt ratio is not unbounded (Blanchard 1984, Kremers 1988, 1989). The computation of this steady state equilibrium requires assuming a steady state value for the discount rate and for other variables. The steady state values can be set equal to historical averages or to those consistent with policy objectives. As an illustration, assuming for a deterministic environment, setting the discount rate equal to m in equation (1) and expressing all the variables as a ratio to GDP, the debt stabilizing primary balance for a desired debt to GDP ratio b^* should be $pb^{ss} = (1-m) \times b^*$. Qualitative judgment and quantitative analysis

could serve to evaluate whether these values are realistic. If not, another policy iteration round might be necessary.

2.2 The asset pricing perspective

More recently, debt sustainability has been examined from an asset pricing perspective (Jiang et al. 2022, 2023, 2024). Similarly to the macroeconomic perspective on debt sustainability, the asset pricing perspective begins with the IGBC. This constraint can be interpreted as a sequence of discounted cash flows, where the cash flows correspond to the projected primary budget balances. Cochrane (2005) argues that, under this view, holding government debt is analogous to holding claims on future primary surpluses, which can, in principle, be valued in a manner similar to corporate debt or equity. While both perspectives share the same economic foundations, they diverge in key aspects, resulting in complementary but distinct insights into debt sustainability. We describe the differences between both approaches below.

The first difference between the two approaches lies in the pricing of aggregate growth risk and treatment of the discount rate. The asset pricing perspective rejects the standard macroeconomic practice of using the risk-free rate—typically assumed to be equal to the government borrowing rate—to discount primary budget balances. Instead, it incorporates a risk premium component in addition to the risk-free rate to price aggregate growth risk. The second difference stems from the application of the transversality condition and the no-arbitrage condition. These conditions imply that the expected present-discounted value of debt in the distant future approaches zero as the time horizon extends to infinity. This optimality condition holds as long as the GDP risk premium exceeds the gap between the economic growth rate and the risk-free rate. In other words, the asset pricing perspective asserts that the sovereign risk-free rate can never be lower than the economy's growth rate in every state of the world. This rules out the case of $r < g$ which, until the low rate environment ended in the post-Covid period, was a major concern in economic policy discussions (Blanchard 2019, 2023; Willems and Zettelmeyer 2022).[4]

The rejection is justified on the grounds that surpluses are procyclical, moving in-sync with the business cycle. In asset pricing parlance, budget balances are not zero beta assets. Hence, the appropriate discount rate should be the risk free rate plus a risk premium, as first noted by Bohn (1995). Finally, rather than analyzing debt dynamics and whether debt stabilizes as the economy reaches its long-run steady state, the assessment of a country's fiscal health is based on whether official primary balance projections are consistent with the market valuation of the country's public debt, as applied to the U.S. by Jiang et al. (2022).

One critical case is when the market value of the government's debt exceeds its discounted

4. There are valid arguments supporting that government debt services unrelated to claims on primary surpluses could at least temporarily justify risk-free rates lower than the growth rate of the economy, as noted in Reis (2022), Jiang et al. (2023), and Willems and Zettelmeyer (2022)

value. There are several possible explanations. The first one is that markets expect future primary balances to exceed those used when projecting the discounted value of the debt. This is the case that Jiang et al. (2023) refer to as a reduction of a country's fiscal capacity. Another reason is that markets might be mispricing the country's debt. In this case, a price correction could trigger a disorderly unwinding of debt portfolios. Finally, government bonds might be viewed as safe assets and providing liquidity during periods of stress. In this case, investors would demand returns lower than those associated with having claims on future primary surpluses. We should note, however, that only a few countries' government bonds, especially the United States, enjoy safe asset status.

The data requirements for the asset pricing perspective are more demanding than those for the macroeconomic perspective. First, the existence of a liquid secondary market for public debt is essential. Second, long-term projections of primary budget balances must be available, or, in their absence, analysts must construct them using reasonable and realistic assumptions. By contrast, the macroeconomic perspective's calculation of the stabilizing primary balance does not require specifying the exact path of primary balances leading to the steady-state equilibrium. Similarly, simulating debt dynamics in the macroeconomic approach typically relies on historical patterns or econometric models.

3 A selective review of the literature on Japan's debt sustainability

The sustained rise of Japan's general government debt to GDP ratio, climbing from just below 50 percent in the early 1980s to a projected 250 percent in 2024, has garnered significant attention in the academic and policy-making discourse on debt sustainability (Figure 1).[5] Several studies have examined the welfare costs imposed by high debt levels and their implications for designing sustainable fiscal policies. This concise review necessarily represents only a selective overview of the extensive literature on Japan's debt dynamics.

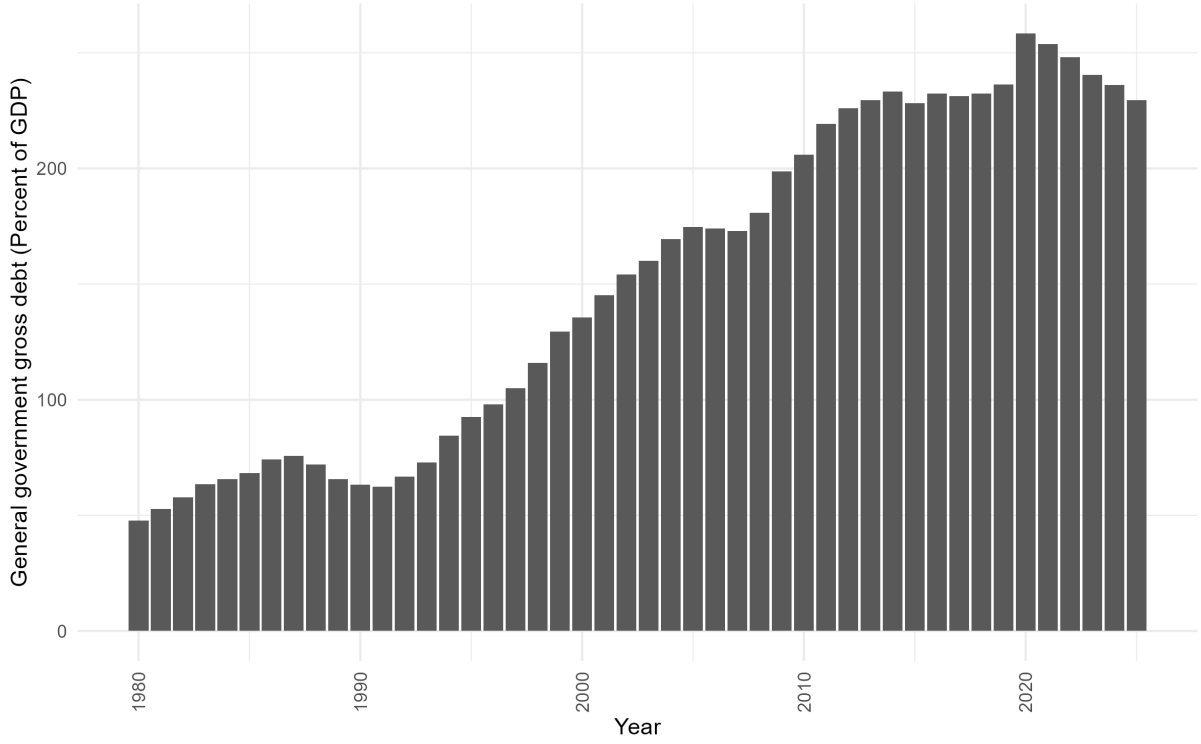
High debt levels negatively impact welfare by crowding out capital, increasing interest payments, and potentially leading to higher distortionary taxes. Nakajima and Takahashi (2017) evaluated welfare losses using a calibrated heterogeneous agent incomplete market model allowing for increasing fiscal uncertainty at high debt levels. They concluded that the optimal debt ratio was approximately 50 percent. However, welfare gains from reducing the debt ratio to this level were marginal, as the potential benefits of reduced fiscal uncertainty were largely offset by welfare losses associated with increased economic inequality.

Hansen and Imrohoroglu (2013) utilized a standard growth model to estimate the fiscal burden, quantifying the additional taxes needed to finance projected expenditures and stabilize government debt. Their findings suggest that achieving debt sustainability, while maintaining

5. This refers to gross debt of the general government.

compliance with the intertemporal budget constraint, requires a significant fiscal adjustment, specifically, raising distortionary taxes, such as consumption or labor income tax, to a range of 30 to 40 percent.

Figure 1: General government debt to GDP ratio, in percent



Sources: IMF; CEIC.

Raising government revenues and debt consolidation are standard tools for ensuring debt sustainability. In this context, Doi, Hoshi, and Okimoto (2011) argued that in the early 2010s, Japan's debt was unsustainable without a permanent and substantial increase in government revenues. They estimated that tax revenues would need to rise from 33 percent to 40-47 percent of GDP. However, the authors concluded that such revenue increases were impractical, given the simultaneous constraints of active fiscal policy and a monetary policy apparently aimed at inflating away the debt. The findings in Futagama and Konishi (2018), based on an endogenous growth model, further supported fiscal consolidation and a reduction in the debt ratio, as both policies could lead to substantial welfare gains. Some of the gains were offset, however, when fiscal consolidation was accompanied by capital, labor and consumption taxes.

The fiscal reaction function, first introduced by Bohn (1998), measures the extent to which the primary fiscal balance adjusts in response to changes in the debt to GDP ratio. This analytical tool is particularly valuable for evaluating debt sustainability and simulating the potential

impact of alternative policy scenarios. Conventionally, fiscal policy is considered stabilizing if primary surpluses increase proportionally with rising debt levels. However, a critical challenge emerges at high debt levels, where political constraints may impair the government's ability to generate primary surpluses. Sakuragawa and Sakuragawa (2020), after estimating the fiscal reaction function for Japan, found that such political constraints were not binding as they were offset by the prevailing negative growth-adjusted bond yields. Yet, this condition has since changed as the BOJ started normalizing rates in late 2024, suggesting a comprehensive reexamination of Japan's fiscal dynamics is needed.

The BOJ holds approximately half of Japan's public debt, which arguably contributes to stabilizing the public debt dynamics. Alberola et al. (2023) contend that traditional macroeconomic DSA frameworks are insufficient to evaluate unconventional monetary policy. Employing a stochastic debt sustainability model within a monetary policy framework, they demonstrated that the central bank's bond purchases had positively impacted debt sustainability. The unwinding of quantitative easing and subsequent reduction of the central bank's bond holdings could exacerbate debt dynamics unless debt is effectively rolled over. Their findings also suggested that continued quantitative easing might be prudent in the face of persistent global financial tightening.

Similarly, Hansen and Imrohoroglu (2023), using a neoclassical growth model, argued that while the BOJ's massive purchases of government bonds temporarily stabilized debt, the impact would be transitory due to growing demographic pressures. However, the central bank's intervention in the Japanese government bond market resulted in significant losses (Fujiki and Tomura 2017), which, if large enough, could translate into negative equity. Arguably, negative equity may not adversely affect central bank operations (Buiter 2020, Cochrane 2023, Bell et al. 2024), which alleviates some concerns regarding the central bank's holdings of government bonds.

4 Debt sustainability in Japan: standard DSA and asset pricing analyses

4.1 Standard DSA

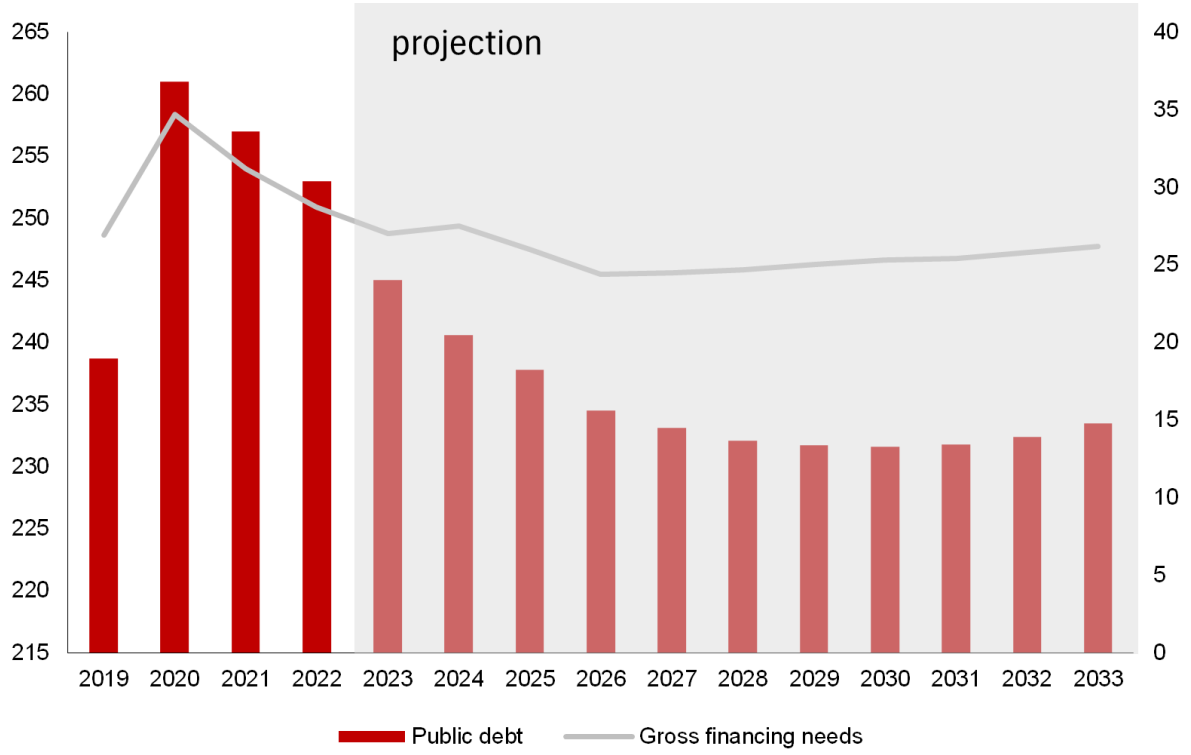
This section summarizes the main findings and conclusions of the DSA conducted in the context of AMRO's 2024 country consultation with Japan (AMRO 2025).[6] The DSA examined general government debt, which includes central and local government debt, and social security obligations. The analysis showed that Japan's public debt had been steadily declining since its pandemic-driven peak of 261 percent of GDP in 2020, reaching 245 percent in 2023. However, this reduction was driven more by favorable debt dynamics—strong economic growth and high

6. The DSA uses the most recent publicly available data, which are of an earlier vintage than those underlying the asset-pricing exercise.

inflation—than by fiscal consolidation. Despite economic recovery, the primary deficit remained high and was unlikely to meet the balanced budget target by 2025. Over 80 percent of the debt consisted of medium- to long-term instruments, with an average maturity of 9.5 years. Domestic institutions, including the BOJ, insurance companies, and banks, held most of the debt, while foreign investors accounted for just 13 percent of government securities.

The DSA assumed a baseline scenario where economic growth would recover steadily, exceeding potential in 2025 and 2026 before stabilizing at its long-term trend. GDP deflator inflation was expected to persist through 2025 and 2026 before settling at 1 percent in the long run. The effective interest rate on total debt was projected to rise gradually over the forecast period, influenced in part by policy rate adjustments, while Japan's extended debt maturity helped moderate the pace of this increase.

Figure 2: Public debt and gross financing needs, percent of GDP



Sources: AMRO (2025); Japan Ministry of Finance; Cabinet Office.

The public debt-to-GDP ratio was expected to decline until 2029 but would rise thereafter due to increasing expenditures from an aging population. Higher effective interest rates and lower GDP deflator inflation would push real interest rates up. As a result, the combination of a growing primary deficit and rising real interest rates would outweigh the impact of real growth, driving debt upward from 2030, reaching 233.5 percent of GDP by 2033 (Figure 2). The

GFN would rise in 2024 due to extended fiscal support and a supplementary budget, decline in 2025–2026 as support would be phased out, and rise again later due to a widening primary deficit.

While public debt and GFNs projections exceeded international benchmarks, the DSA and macro stress tests considered several mitigating factors that could moderate debt sustainability risk. Due to the long maturity of Japan's debt portfolio, which averages almost 10 years, higher future interest rates would only gradually increase debt servicing costs. Exchange rate risk was minimal, as the debt has been predominantly issued in local currency. Additionally, the large domestic investor base would provide a stable source of government financing, likely sufficient to meet the country's significant public funding needs. The historical role of the Japanese yen as a safe-haven currency would further bolster investor confidence and support demand for Japanese government bonds (JGBs).

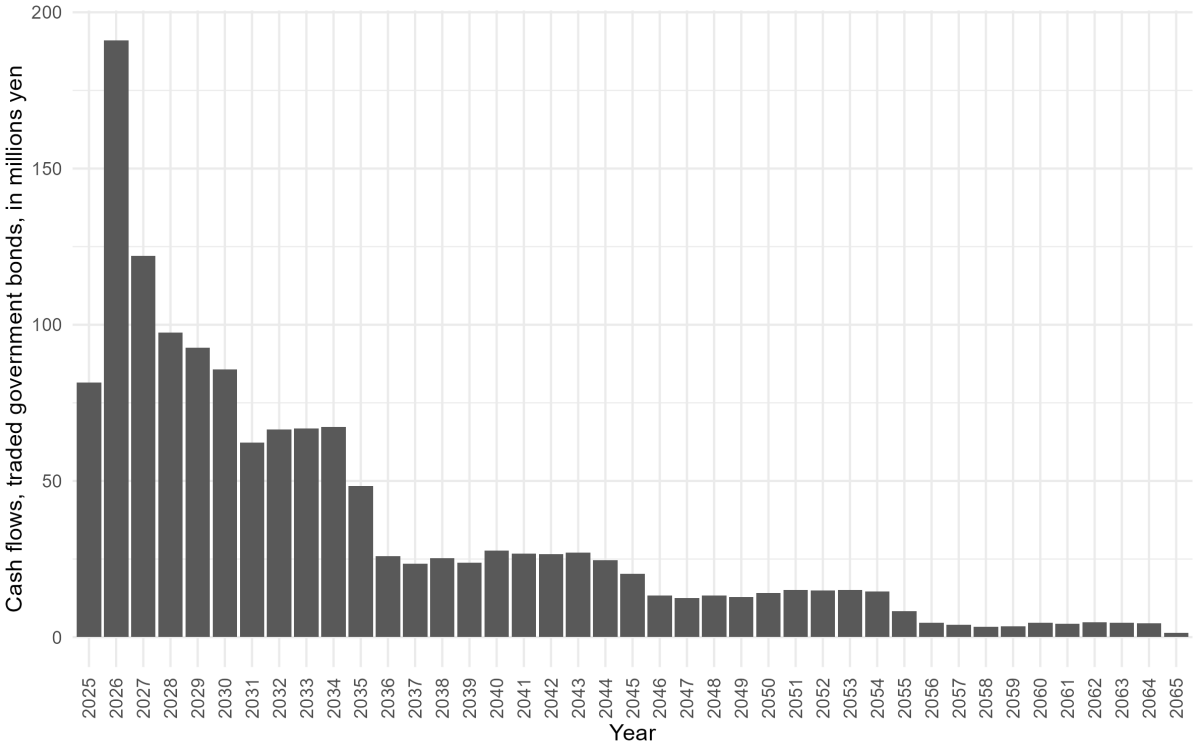
Notwithstanding these mitigating factors, with public debt projected to rise steadily under both the baseline and shock scenarios, the need for gradual fiscal consolidation remained critical. Rising expenditures, particularly due to an aging population, and the potential for increasing interest rates posed risks to long-term debt sustainability. To mitigate these challenges, authorities needed to implement a fiscal consolidation strategy that streamlined expenditures and enhanced revenue mobilization, ensuring a more sustainable debt trajectory.

4.2 Asset pricing analysis

Applying the asset pricing methodology required data on the market value of outstanding government debt, long-term economic and fiscal projections, and appropriate discount rates. We obtained the market value of outstanding government debt from Bloomberg LLC. The market data corresponded to 588 active government securities outstanding as of October 21, 2025, with a notional principal of 1287 trillion yen and a market value of 1192 trillion yen. Principal and coupon payment cash flows are shown in Figure 3. The analysis errs on the conservative side by assuming that the BOJ acts as the residual claimant, receiving payments only after other bondholders have redeemed their bonds.[7] Hence, future primary surpluses are reserved exclusively for investors in the secondary market.

7. Were the central bank not paid, it would incur losses and be saddled with negative equity. However, as noted in the literature review discussion, negative equity should not necessarily have an adverse effect on the bank's operations.

Figure 3: Cash flows, traded government debt, in million yen



Sources: Bloomberg LLP and authors' calculations.

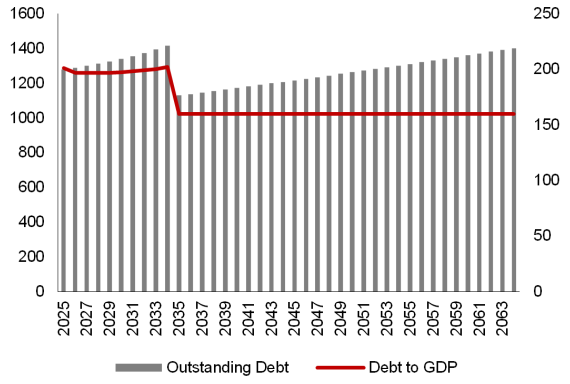
Past and long-term forecasts for inflation, GDP growth, and fiscal projections were obtained from the official Economic and Fiscal Projections for Medium- to Long-Term Analysis in the Cabinet Office (August 2025) report, which was submitted to the Council on Economic and Fiscal Policy on August, 2025.[8] These projections cover both historical and future fiscal trends from 2023 to 2034 under two scenarios: one reflecting a continuation of past trends and another representing a transition to a new economic stage. We refer to the former as the baseline scenario and the latter as the optimistic scenario. In the optimistic scenario, the Cabinet Office assumed higher TFP growth alongside increased labor force participation among women and the elderly. The projected rise in TFP growth was driven by medium- to long-term planned investments in priority areas, while the increase in labor force participation was attributed to heightened labor demand fueled by economic growth.

In the baseline scenario, it was assumed that the debt-to-GDP ratio was at 200 percent in 2025, and then grew to 202 percent by 2034. In the optimistic scenario, the debt-to-GDP ratio was assumed to be at 201 percent and gradually decline to 174 percent by 2034. Our analysis extended the projections until 2064 by assuming a large and permanent reduction in

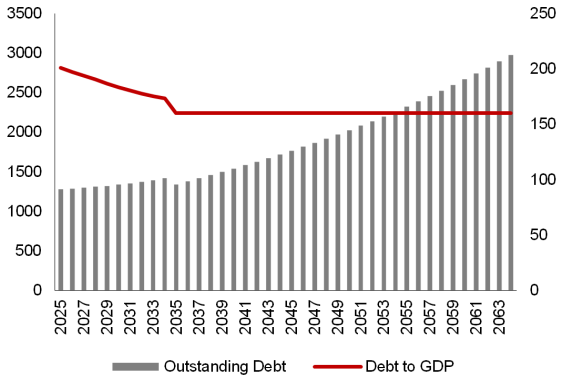
8. The Cabinet Office's projections appear to be more cautiously optimistic compared to those of AMRO and the IMF.

the debt-to-GDP ratio to 160 percent[9] in 2035 which remains constant onward (Figure 4).

Figure 4: Debt projection and debt-to-GDP ratio, in trillion yen; in percent



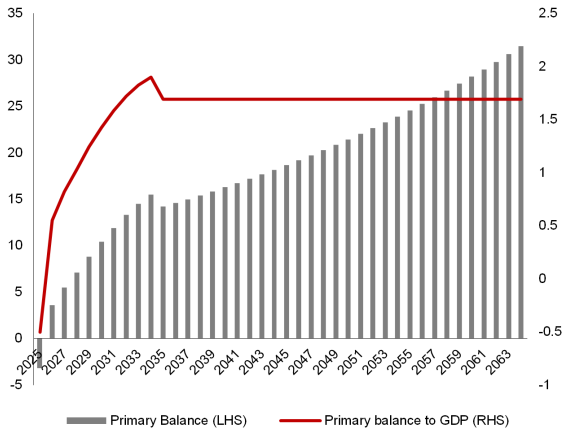
Baseline scenario



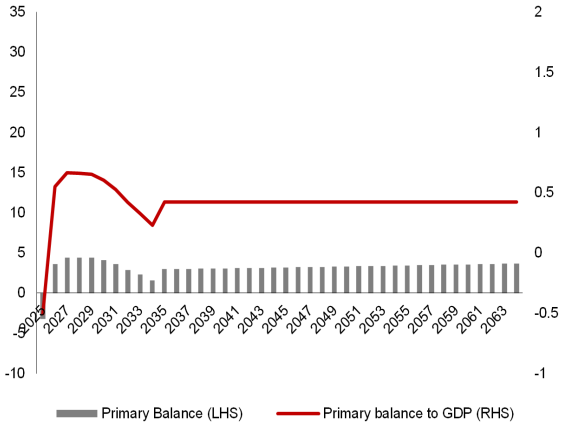
Optimistic scenario

Sources: Cabinet Office and authors' calculations.

Figure 5: Primary balance projections, in trillion yen; in percent



Baseline scenario



Optimistic scenario

Sources: Cabinet Office and authors' calculations.

Similarly, some adjustments were needed to project GDP growth and the primary balance-to-GDP ratio beyond the official projections that ended in 2034. First, the GDP growth rate was assumed to remain constant at its 2034 value until 2064. Second, past 2034, the primary balance-to-GDP ratio was set equal to its average value computed over the 5-year period ending in 2033 and kept constant until 2064. Under these assumptions, the baseline scenario projection

9. This figure is considered consistent with the steady-state value, based on anecdotal evidence gathered through discussions with academics.

of the primary balance stabilized at approximately 0.42 percent of nominal GDP from 2034 onward, while in the optimistic scenario, it reached 1.69 percent of nominal GDP (Figure 5).

4.2.1 Construction of discount curves

We constructed the discount rate curve using two different estimates of the sovereign risk premium using October 2025 data.[10] The first estimate, following Jiang et al. (2022), set the sovereign risk premium equal to the economy-wide unlevered equity risk premium (ERP). The second estimate set the premium equal to the price of credit default swap (CDS) contracts. Once the premia were calculated, two discount rates curves were constructed by simply adding them to the risk-free rate curve.

The equity risk premium approach assumes that claims on primary budgets are equivalent to claims on GDP and, in turn, equivalent to claims on the dividends of the country's publicly listed stocks (Jiang et al. 2022). In this case, the equity risk premium, corrected after the leverage effect is removed, then serves as a proxy for the sovereign risk premium. Following the suggested methods in Jiang et al. (2023), we first set the country's equity risk premium to 5.27 percent, the January 2025 value calculated by Damodaran (2025) using a discounted dividend model (Damodaran 2024). To compute the unlevered equity risk premium, it was necessary to estimate the equity-to-asset ratio. This ratio was calculated as the average of the ratios of the non-financial firms and the financial firms weighted by total assets.

As of the end of the third quarter of 2024, the equity-to-asset ratio of the nonfinancial firms sector was 0.424, calculated using shareholder equity of ¥897 trillion and total assets of ¥2114 trillion, as reported by the Policy Research Institute of Japan's Ministry of Finance. The equity-to-asset ratio of the financial sector was calculated as follows. First, it was assumed that the debt-to-equity ratio of financial corporations in 2025 remained unchanged at 6.5, the value reported by the OECD at the end of 2024[11]. The corresponding equity-to-asset ratio was 0.133. The total assets of financial institutions were set equal to their June 2025 value of ¥5156 trillion. As a result, the average equity-to-asset ratio was calculated as 0.133:

$$0.424 \times \frac{2114}{2114 + 5156} + 0.133 \times \frac{5156}{2114 + 5156}$$

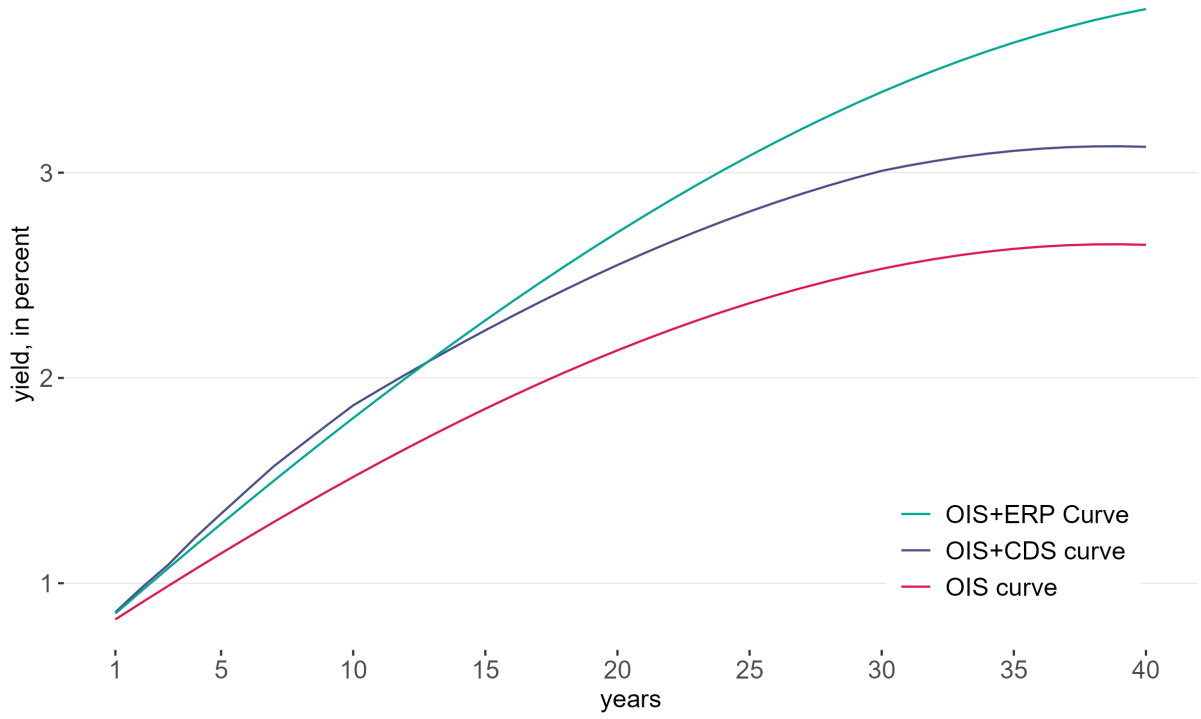
This yielded an unlevered equity risk premium of 1.15 percent. This premium, assumed to be equal to the sovereign risk premium, was held constant for all horizons.

The prices of sovereign credit default swaps (CDS) contracts denominated in Japanese yen were also used as a proxy for the sovereign risk premium. These contract prices are quoted as spreads over the risk-free rate. Since CDS contracts function as insurance against sovereign de-

10. Other approaches, such as estimating a general stochastic discount factor, are discussed in Jiang et al. (2024).
11. See https://www.oecd.org/en/data/indicators/financial-corporations-debt-to-equity-ratio.html

fault, their spreads should reflect fiscal risks (Lando 2020). In principle, no arbitrage arguments suggest that sovereign CDS-bond basis—the difference between the CDS spread and the spread of the sovereign bond referenced by the CDS contract—should be small. Otherwise, basis arbitrage trades would cause the CDS and bond spreads to converge (Duffie 1999, Hull and White 2000). However, arbitrage costs could lead to a persistent positive CDS bond basis, as documented for European countries (Gyntelberg et al. 2017) and emerging markets (Chan-Lau and Kim 2004, Ammer and Cai 2011).[12] In this case, the market value of outstanding government bonds would exceed their net present value calculated using the CDS-based discount factor. CDS spreads data were available for maturities of 1, 2, 3, 4, 5, 7, 10, 20, and 30 years from Refinitiv. Cubic splines were used to interpolate between 1-year to 30-year maturities, With the assumption that the CDS spread for maturities beyond 30 years remained equal to the 30-year CDS spread.

Figure 6: OIS curve, CDS discount curve, and equity premium discount curve



Sources: Refinitiv and authors' calculations.

Once the equity and CDS premia were determined, the only remaining task was to construct the risk-free rate curve. Following Hull and White (2013), the risk-free rate curve was set equal to that of the overnight indexed swap (OIS) rate curve, which has become the standard risk-free

12. See Culp, van der Merwe, and Starkle (2018) for a comprehensive discussion of the CDS-bond basis.

benchmark since the 2008 global financial crisis. Japan's OIS rates were obtained from Refinitiv for maturities of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30 and 40 years. Unobserved values for maturities within this range were estimated by fitting a cubic spline to the observed values. Subsequently, the equity premium discount rate curve and the CDS discount rate were derived by adding each respective premium to the risk-free rate. The corresponding discount rates, along with the OIS curve, are shown in Figure 6.

With the discount rate curves available, two calculations were performed. First, we computed the discounted value of the primary surpluses in both scenarios, to which the discounted value of the debt stock in year 2064—the end of the projection periods—was added. This value was then compared with the market value of the debt to evaluate the consistency of the market valuation with fiscal projections.

To perform this calculation, in equation (1) the equity premium and CDS discount rates were substituted for the discount factor $M_{t,t+h}$, while the primary surpluses were used as the cash flows. Second, we evaluated whether the market was correctly pricing the cash flows associated with the coupon and principal repayments of traded government securities. This calculation included only traded government securities, which had a market value of ¥1192 trillion as of October 21, 2025, according to Bloomberg.

Additionally, for this second evaluation, we computed the internal rates of return (IRR) consistent with the discounted value and market value of government debt, respectively, by solving:

$$0 = \sum_{t=0}^{T} \frac{pb_t}{(1+IRR)^t} - D_0, \tag{3}$$

where D_0 was set first to the discounted value of the debt and then to its market value. The IRR derived from the market value may differ from the IRR based on the discounted debt value. This difference could reflect the market's valuation of the services provided by government debt, such as seigniorage and its role as a liquid, safe-haven asset. Alternatively, it might indicate market mispricing, with the gap representing the additional potential cost the government could face to service its debt if prices realign with fundamentals. Determining the primary driver of this IRR difference likely requires evidence beyond the DSA itself.

4.2.2 Results

The valuation exercise reveals a substantial gap between market values and the discounted present value implied by baseline fiscal projections, while optimistic assumptions bring the two much closer together (Table 1 and Figure 7). Under the baseline scenario, the discounted value of projected primary balances plus the terminal debt stock amounts to only ¥485 trillion using the

OIS+CDS curve and ¥388 trillion using OIS+ERP—covering just 33–41 percent of the current market value of outstanding JGBs (¥1,192 trillion). By contrast, the optimistic scenario yields discounted values of ¥1,257 trillion and ¥1,035 trillion, broadly closing the valuation gap and suggesting that market pricing is more closely aligned with optimistic fiscal expectations than with baseline assumptions.

Government asset holdings provide only limited mitigation to this valuation gap. Japan's general government holds about ¥788 trillion in assets (FY2023)[13]. However, many financial assets are offset by corresponding liabilities, and a sizable share consists of non-liquid items such as fixed assets and capital investments that cannot be readily converted into cash. As a result, only about ¥65 trillion in cash and deposits is sufficiently liquid to be available for fiscal operations. Adding these liquid assets to the present value of projected fiscal balances has only a modest effect and does not materially narrow the gap relative to the market value of government debt (Figure 7).

Table 1: Key findings in asset pricing approach, in trillion yen

	Market value	Discounted cash flow	Discounted primary balances and debt projections	
			Baseline	Optimistic
	(1)	(2)	(3)	(4)
OIS + CDS	1192	1193	485 (76 + 409)	1257 (388 + 869)
OIS + ERP	1192	1187	388 (73 + 315)	1035 (364 + 671)

Source: Authors' calculations.

While long-horizon fiscal projections imply a sizable valuation gap, the pricing of JGBs remains consistent when evaluated against their contractual cash flows. When future coupon and principal payments are discounted using the same risk-adjusted curves, the resulting valuations, ¥1,187 trillion (OIS+CDS) and ¥1,193 trillion (OIS+ERP)—are close to observed market prices. This suggests that current JGB pricing is anchored in near-term payment promises and prevailing risk premia, rather than in the long-run fiscal capacity needed to generate primary surpluses.

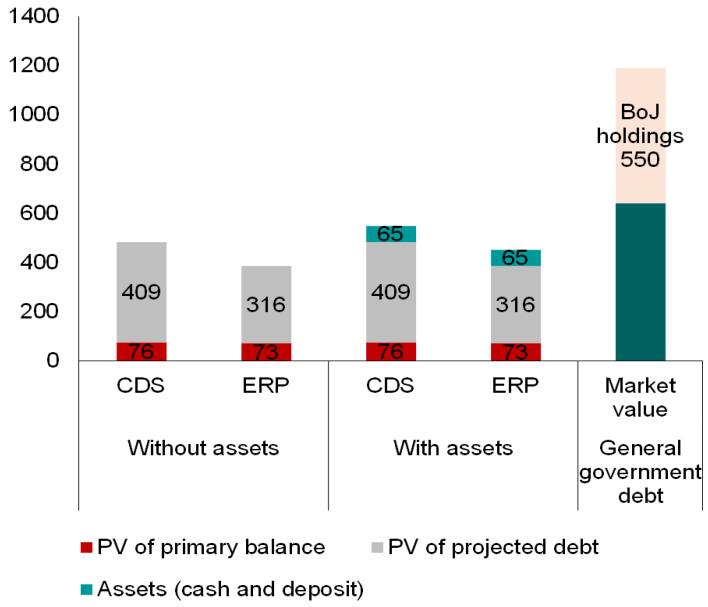
Japan's valuation gap shares similarities with earlier findings for U.S. Treasuries. Jiang et al. (2022, 2023, 2024) show that U.S. debt valuations imply expectations of future primary surpluses several times larger than official projections, indicating that investor confidence and liquidity considerations play a central role in pricing sovereign bonds. Japan's baseline results exhibit a comparable disconnect between market prices and fiscal projections; however, Japan differs in that optimistic projections, which incorporate higher productivity growth and labor

13. Government asset data from Japanese Public Finance Fact Sheet (April, 2025), accessed from: https://www.mof.go.jp/english/policy/budget/budget/fy2025/02.pdf

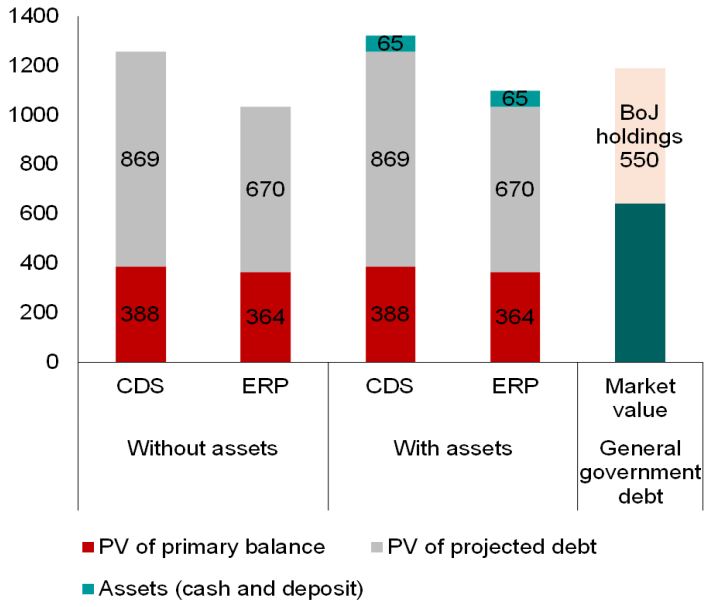
force participation, substantially reduce the valuation gap.

Figure 7: Key findings in asset pricing approach with assets, in trillion yen

Baseline scenario



Optimistic scenario



Sources: Authors' calculations; Japan Ministry of Finance; Bank of Japan; Cabinet Office; Bloomberg; CEIC.

Table 2: Internal rate of return, in percent

	Internal rate of return
Market value implied	2.08
OIS+CDS	2.11
OIS+ERP	2.18
Non-BOJ holdings implied	2.4

Source: Authors' calculations.

A key factor behind this disconnect is the large share of JGBs held by the BOJ, which is associated with reduced sensitivity of market pricing to long-term fiscal fundamentals. As of October 2025, the BOJ holds roughly ¥550 trillion in JGBs, nearly half of the total, leaving about ¥650 trillion in the hands of non-BOJ investors. These private holdings are priced much more consistently with the discounted value of baseline fiscal surpluses (Figure 7), suggesting that investors could implicitly treat future primary balances as supporting primarily the free-float portion of debt, with the BOJ acting as a residual absorber of fiscal risk.

Market pricing also appears to incorporate a stronger long-run fiscal outlook than assumed in the baseline projections. The market-consistent discount rates inferred from bond prices, 2.11 percent (OIS+CDS) and 2.18 percent (OIS+ERP), are in line with prevailing yields (Table 2). Yet matching the present value of baseline fiscal surpluses to the market value of total debt would require a discount rate of only 0.7 percent. This implausibly low rate highlights how long-horizon fiscal fundamentals exert limited influence on aggregate JGB valuations, which continue to be shaped by liquidity conditions, BOJ balance-sheet support, and short-to-medium-term pricing behavior.

Comparisons with standard DSA reinforce the distinction between accounting-based sustainability and market-based valuation. Market-consistent discount rates inferred from JGB prices (2.11 percent under OIS+CDS and 2.18 percent under OIS+ERP) are much higher than the average effective interest rate embedded in recent DSA assessments, reflecting past borrowing at exceptionally low yields. This difference highlights a forward-looking risk: as refinancing occurs at higher rates, debt servicing costs will rise unless primary balances improve.

Taken together, these results indicate that Japan's current bond market pricing relies on two conditions: continued balance-sheet support and price-insensitive demand from the BOJ and domestic institutions; and a fiscal trajectory closer to the optimistic scenario than the baseline projection. If either support weakens—through reduced BOJ holdings, rising foreign participation, or weaker fiscal performance—the valuation gap exposed under the baseline scenario could become more relevant for market pricing.

5 Conclusions

Japan, among advanced economies, has the highest debt-to-GDP ratio, which leads to examining whether its debt will be sustainable going forward. We studied this issue from two complementary perspectives, the conventional DSA approach and the asset pricing approach. The DSA suggested that the high public debt levels and gross financing needs, which currently exceed international benchmarks, have not yet posed substantial risks to debt sustainability because there are several mitigating factors, including the debt's long-term maturities, little debt issued in foreign currency, and a stable domestic investor base. However, with public debt projected to increase steadily in both baseline and shock scenarios, the importance of gradual fiscal consolidation remains crucial.

The asset-pricing analysis indicates that current market valuations appear more optimistic than the fiscal outlook embedded in baseline projections. Under the baseline fiscal scenario, the discounted value of projected primary surpluses and terminal debt stock falls well below the current market value of outstanding JGBs, indicating a sizable valuation gap and suggesting that market prices are not fully anchored to baseline fiscal fundamentals. By contrast, valuations under the optimistic fiscal scenario come close to current market prices, implying that market participants may be assigning greater weight to more favorable long-term fiscal outcomes.

This more optimistic pricing becomes even more evident once the composition of bondholders is considered. The BOJ holds nearly half of outstanding JGBs, and when the valuation exercise is confined to the free-float portion held by private investors, the present value of future fiscal surpluses is broadly aligned with market pricing. In addition, when future contractual cash flows are discounted using market-based rates, the resulting valuations nearly match current market prices—implying that investors continue to treat JGBs as low-risk assets supported by prevailing market conditions and policy settings, rather than by long-horizon fiscal fundamentals.

The seemingly sanguine market view should not be taken for granted, as investor sentiment can shift rapidly as market conditions change. This was evident in 2024 when changing investor sentiment triggered a massive unwinding of the yen carry trade (Aquilina et al. 2024, Shi and Pande 2024). In addition, according to Japan Ministry of Finance (2024), many of the government assets are either not readily marketable or could lose significant value in a fiscal crisis. Hence, steering the economy toward the optimistic scenario should remain a policy priority. Japan has benefited from stable debt dynamics supported by past central bank policies and strong domestic investor demand. However, these conditions should not be taken for granted. As the BOJ gradually shifts away from its prolonged accommodative stance, rising interest rates could increase borrowing costs and introduce new fiscal challenges. Even if markets remain accommodative and tolerate deviations from fiscal fundamentals for an extended period, this will

only amplify future risks.

In the future, Japan's ability to maintain debt sustainability will depend on a combination of prudent debt management, revenue-enhancing strategies, and structural reforms. Incorporating government assets into fiscal planning strengthens Japan's position, but maintaining investor confidence requires proactive measures. Transparent fiscal governance, clear communication with market participants, and policies that promote long-term economic growth will be crucial to mitigating volatility. Together, these considerations suggest that while Japan's debt sustainability appears resilient for now, the evolving economic landscape necessitates continued vigilance. Policymakers must strike a delicate balance between maintaining fiscal credibility and supporting economic growth, ensuring that Japan's fiscal framework remains robust amid mounting global uncertainties.

References

Alberola, E., G. Cheng, A. Consiglio, and S.A. Zenios. 2023. "Unconventional monetary policy and debt sustainability in Japan." *Journal of the Japanese and International Economies* 69 (101274). https://doi.org/10.1016/j.jjie.2023.101274.

Ammer, J., and F. Cai. 2011. "Sovereign CDS and bond pricing dynamics in emerging markets: does the cheapest-to-deliver option matter?" *Journal of International Financial Markets, Institutions and Money* 21 (3): 369–387. https://doi.org/10.1016/j.intfin.2011.01.001.

Aquilina, M., M. Lombardi, A. Schrimpf, and V. Sushko. 2024. The market turbulence and carry trade unwind of August 2024. BIS Bulletin 90. Basel: Bank for International Settlements. https://www.bis.org/publ/bisbull90.pdf.

ASEAN+3 Macroeconomic Research Office. 2024. ASEAN+3 fiscal policy report 2024: transitioning to fiscal normality. Policy Perspectives Paper PP/24-01. Singapore: ASEAN+3 Macroeconomic Research Office. https://www.imf.org/-/media/Files/Publications/PP/2022/English/PPEA2022039.ashx.

———. 2025. Annual Consultation Report Japan - 2024. AMRO Country Reports ACR/25-02. Singapore: ASEAN+3 Macroeconomic Research Office (AMRO). https://amro-asia.org/wp-content/uploads/2025/03/1.-Japan-ACR-2024_for-Publication.pdf.

Bell, S., J. Frost, B. Hofmann, D. Sandri, and H.-S. Shin. 2024. Central bank capital and trust in money: lessons fro history for the digital age. BIS Papers 146. Basel: Bank for International Settlements. https://www.bis.org/publ/bppdf/bispap146.pdf.

Blanchard, O. 1984. "Current and anticipated deficits, interest rates and economic activity." *European Economic Review* 25 (1): 7–27. https://doi.org/10.1016/0014-2921(84)90067-9.

———. 2019. "Public debt and low interest rates." *American Economic Review* 109 (4): 1197–1229. https://doi.org/10.1257/aer.109.4.1197.

———. 2023. *Fiscal policy under low interest rates.* Cambridge, MA: MIT Press.

Bohn, H. 1995. "The sustainability of budget deficits in a stochastic economy." *Journal of Money, Credit and Banking* 27 (1): 219–238. https://doi.org/10.2307/2077862.

———. 1998. "The behavior of U.S. public debt and deficits." *The Quarterly Journal of Economics* 113 (3): 949–963. https://doi.org/10.1162/003355398555793.

Bouabdallah, O., C. Checherita-Westphal, T. Warmedinger, F. de Stefani R. an Drudi, R. Setzer, and A. Westphal. 2017. Debt sustainability analysis of euro area sovereigns: a methodological framework. Occassional Paper Series 185. Frankfurt, Germany: European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpops/ecbop185.en.pdf.

Brunnermeier, M.K., M. Pagano, L. Garicano, R. Reis, P. Lane, T. Santos, D. Thesmar, S. Van Nieuwerburgh, and D. Vayanos. 2016. The sovereign-bank diabolic loop and ESBIES. NBER Working Paper Series 21993. https://www.nber.org/system/files/working_papers/w21993/w21993.pdf.

Buiter, W. 2020. *Central banks as fiscal players: the drivers of fiscal and monetary policy space.* Cambridge, UK: Cambridge University Press.

Cabinet Office. 2025. Economic and fiscal projections for medium to long term analysis. Technical report. Government of Japan, August.

Chan-Lau, J.A., and Y.S. Kim. 2004. Equity prices, creditd default swaps and bond spreads in emerging markets, IMF Working Paper WP/04/27. International Monetary Fund. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=564241.

Cochrane, J.H. 2005. "Money as stock." *Journal of Monetary Economics* 52 (3): 501–28. https://doi.org/10.1016/j.jmoneco.2004.07.004.

———. 2023. *The fiscal theory of the price level.* Princeton, NJ: Princeton University Press.

Culp, C.L., A. van der Merwe, and B.J. Starkle. 2018. *Credit defaul swaps.* Palgrave Studies in Risk and Insurance. Switzerland: Palgrave Macmillan.

D'Erasmo, P., E.G. Mendoza, and J. Zhang. 2016. "What is a sustainable public debt?" In *Handbook of Macroeconomics,* edited by J.B. Taylor and H. Uhlig, vol. 2B. Elsevier B.V. https://doi.org/10.1016/bs.hesmac.2016.03.013.

Damodaran, A. 2024. Equity risk premiums (ERP): determinants, estimation, and implications - the 2024 edition. Working paper. Stern School, New York University. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4751941.

———. 2025. "https://pages.stern.nyu.edu/ adamodar/." Accessed January 9, 2025. http://web.archive.org/web/20080207010024/http://www.808multimedia.com/winnt/kernel.htm.

Doi, T., T. Hoshi, and T. Okimoto. 2011. "Japanse government debt and sustainability of fiscal policy." *Journal of the Japanese and International Economies* 25:414–433. doi:10.1016/j.jjie.2011.09.006.

Duffie, D. 1999. "Credit swap valuation." *Financial Analysts Journal,* no. 83, 635–655. https://doi.org/10.2469/faj.v55.n1.2243.

Escolano, J. 2010. A practical guide to public debt dynamics, fiscal sustainability, and cyclical adjustment of budgetary aggregates. Technical notes and manuals. Washington, DC: International Monetary Fund. https://www.imf.org/external/pubs/ft/tnm/2010/tnm1002.pdf.

Farhi, E., and J. Tirole. 2018. "Deadly embrace: sovereign and financial balance sheets doom loops." *Review of Economic Studies* 85 (3): 1781–1823. https://www.jstor.org/stable/26543949.

Fujiki, H., and H. Tomura. 2017. "Fiscal cost to exit quantitative easing: the case of Japan." *Japan and the World Economy* 42:1–11. https://doi.org/10.1016/j.japwor.2017.02.003.

Futagama, K., and K. Konishi. 2018. "Dynamic analysis of budget policy rules in Japan." *Journal of the Japanese and the International Economies* 50:72–88. https://doi.org/10.1016/j.jjie.2018.09.003.

Gyntelberg, J., P. Hordahl, K. Ters, and J. Urban. 2017. Arbitrage costs and the persistent non-zero CDS-bond basis: evidence from intraday eruo area sovereign debt markets, BIS Working Papers 631. Bank for International Settlements. https://www.bis.org/publ/work631.pdf.

Hansen, G., and S. Imrohoroglu. 2013. Fiscal Reform and Government Debt in Japan: A Neoclassical Perspective. Working Paper, Working Paper Series 19431. National Bureau of Economic Research. https://doi.org/10.3386/w19431. http://www.nber.org/papers/w19431.

———. 2023. "Demographic change, government debt and fiscal sustainability in Japan: the impact of bond purchase by the Bank of Japan." *Review of Economic Dynamics* 50:88–105. https://doi.org/10.1016/j.red.2023.07.007.

Hull, J., and A. White. 2000. "Valuing credit default swaps I: no counterparty default risk." *The Journal of Derivatives* 8 (1): 29–40. https://10.3905/jod.2000.319115.

———. 2013. "LIBOR vs. OIS: the derivatives discounting dilemma." *Journal of Investment Management* 11 (3): 14–27.

International Monetary Fund. 2022. Staff guidance note on the sovereign risk and debt sustainability framework for market access countries. Washington, DC: International Monetary Fund. https://www.imf.org/-/media/Files/Publications/PP/2022/English/PPEA2022039.ashx.

———. 2024a. 2024 Article IV Consultation - Press Release; Staff Report; and Statement by the Executive Director for Japan. IMF Country Report No. 24/118. Washington, DC: International Monetary Fund. https://www.imf.org/-/media/Files/Publications/PP/2022/English/PPEA2022039.ashx.

———. 2024b. Fiscal Monitor: putting a lid on public debt. Washington, DC: International Monetary Fund. https://www.imf.org/-/media/Files/Publications/PP/2022/English/PPEA2022039.ashx.

Japan Ministry of Finance. 2024. Japan Public Finance Fact Sheet. Technical report. Ministry of Finance, Japan. https://www.mof.go.jp/english/policy/budget/budget/fy2024/02.pdf.

Jiang, Z., H. Lustig, S. Van Nieuwerburgh, and M.Z. Xiaolan. 2022. "Measuring US fiscal capacity using discounted cash flow analysis." *Brookings Papers on Economic Activity* Fall (4): 157–209. https://www.brookings.edu/wp-content/uploads/2022/09/BPEA-FA22_WEB_Jiang-et-al.pdf.

———. 2023. "Fiscal capacity: an asset pricing perspective." *Annual Review of Financial Economics* 15:197–219. https://doi.org/10.1146/annurev-financial-110921-10365.

———. 2024. "The U.S. public debt valuation puzzle." *Econometrica* 92 (4): 1309–1347. https://doi.org/10.3982/ECTA20497.

Kremers, J.J.M. 1988. "Long-run limits on the US federal debt." *Economics Letters* 28 (3): 259–262. https://doi.org/10.1016/0165-1765(88)90127-9.

———. 1989. "U.S. federal indebtedness and the conduct of fiscal policy." *Journal of Monetary Economics* 23 (2): 219–238. https://doi.org/10.1016/0304-3932(89)90049-4.

Lando, D. 2020. "Credit defautl swaps: a primer and some recent trends." *Annual Review of Financial Economics* 12:177–192. https://doi.org/10.1146/annurev-financial-012820-013740.

Medas, P., T. Poghosyan, Y. Xu, J. Farah-Yacoub, and K. Gerling. 2018. "Fiscal crises." *Journal of International Money and Finance* 88:191–207. https://doi.org/10.1016/j.jimonfin.2018.08.001.

Nakajima, T., and S. Takahashi. 2017. "The optimum quantity of debt for Japan." *Journal of the Japanese and International Economies* 46:17–26. http://dx.doi.org/10.1016/j.jjie.2017.08.002.

Reinhart, C.M., and K.S. Rogoff. 2010. "Growth in a time of debt." *American Economic Review* 100 (2): 573–578. DOI:%2010.1257/aer.100.2.573.

Reinhart, C.M., K.S. Rogoff, and M.A. Savastano. 2003. "Debt intolerance." *Brookings Papers on Economic Activity* 1:1–74. https://www.brookings.edu/wp-content/uploads/2003/01/2003a_bpea_reinhart.pdf.

Reis, R. 2022. "Debt revenue and the sustainability of public debt." *Journal of Economic Perspectives* 36 (4): 103–124. https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.36.4.103.

Sakuragawa, M., and Y. Sakuragawa. 2020. "Government fiscal projection and debt sustainability." *Japan and the World Economy* 54 (101010). https://doi.org/10.1016/j.japwor.2020.101010.

Shi, A.R., and P. Pande. 2024. Understanding Currency Carry Trades: The Yen Carry Trade and Its Impact on ASEAN+3 Economies. Analytical Note. Singapore: ASEAN+3 Macroeconomic Research Office. https://amro-asia.org/wp-content/uploads/2024/12/20241219-Analytical_Note_Carry_Trade.pdf.

Willems, T., and J. Zettelmeyer. 2022. "Sovereign debt sustainability and central bank credibility." *Annual Review of Financial Economics* 14:75–95. https://doi.org/10.1146/annurev-financial-112921-110812.