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ARTICLE

Survey of demographics, family, and fiscal sustainability in Japan: macroeconomic approaches

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Abstract

Japan faces rapid population aging, persistently low fertility, and an exceptionally high level of public debt. This paper surveys macroeconomic research linking demographic change and fiscal sustainability in Japan, focusing on the dynamics of government expenditures and revenues through the transformation of the fiscal system and the labor market. Since the 2000s, the main source of fiscal pressure has shifted to the expansion of age-dependent social insurance expenditures, including public pensions, health insurance, and long-term care, and we survey studies analyzing the roles of these policies. We also explore fiscal sustainability through labor market adjustments, focusing on research on elderly and female labor force participation, immigration, intra-household decision making, and family formation, based on empirical evidence and structural life-cycle and overlapping generations models. Fiscal outcomes are shown to depend on household responses to policy, and the literature emphasizes that stabilizing Japan's long-run fiscal trajectory requires comprehensive reforms.

Keywords Public debt · Demographics · Family · Overlapping generations model · Japanese economy

JEL Classification E62 · H51 · H55 · H63

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Contents

1 Introduction

Japan confronts a combination of fiscal and demographic pressures that has few historical or international precedents. Public debt has risen to exceptionally high levels since the 1990s, while economic growth remained persistently weak and the population has aged rapidly amid sustained low fertility. In the early stages, fiscal deterioration reflected stimulus fiscal policies aimed at stabilizing the economy after the collapse of the asset price bubble. Over time, however, the dominant source of fiscal imbalance has shifted toward structural forces, most notably the expansion of social insurance expenditures associated with population aging and the contraction of the working-age population. These trends pose questions about the sustainability of Japan's fiscal system and the capacity of the economy to keep sufficient labor input and tax revenues to finance rising expenditures in the medium to long run.

Macroeconomic and fiscal outcomes are tightly connected with not only demographic dynamics, but also household behavior over the life-cycle, and fiscal and labor market institutions. Labor supply and saving decisions over the life-cycle and the responses to changes in social insurance systems, as well as family formation choices jointly shape the tax base, benefit expenditures, fiscal balance, and aggregate economic performance. Assessing fiscal sustainability requires frameworks that explicitly incorporate behavioral responses of households to shifts in the economic environment and general equilibrium feedbacks. The macroeconomic literature reviewed in this survey emphasizes that a unified framework that incorporates dynamics of demographic structure and household behavior are central to the assessment.

Over the decades since the World War II, Japan has also experienced a remarkable health transformation. Life expectancy has risen from just over 50 years to nearly 85, placing Japan among the highest in the world. The introduction of universal health insurance in the 1960s and long-term care insurance in 2000 successful provided

high-quality care services at relatively low cost. Public pensions have also supplied the elderly with the financial resources necessary to maintain healthy living standards. Despite its well-developed social insurance system, Japan's overall tax burden has remained relatively low compared with other advanced economies.

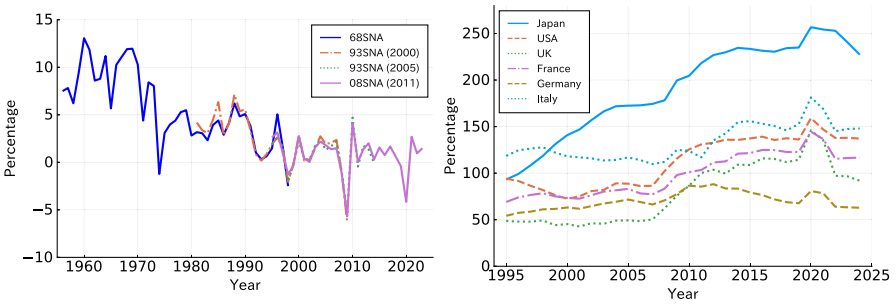
As a consequence, government debt has continued to rise, reaching the highest level among OECD countries. With the old-age dependency ratio projected to increase further in the coming decades, expenditures on social insurance programs will inevitably grow, while the labor force continues to shrink. These trends raise concerns about the sustainability of the fiscal system and and about what policies can to increase labor input to maintain productive capacity.

Given this background, this paper surveys and integrates recent macroeconomic research on Japan that links fiscal policy, demographic change, and household behavior within quantitative frameworks. We synthesize findings from accounting approaches, empirical studies, and structural life-cycle and overlapping generations models to clarify the mechanisms through which aging, fertility decline, and institutional incentives shape household decisions, macroeconomic outcomes, and government budgets. Rather than evaluating the effects of individual policies in isolation, the survey emphasizes how interactions across fiscal systems, labor markets, and household decisions affect consequences of the demographic transition in the medium to long run. We provide a coherent perspective on the sources of Japan's fiscal pressures, the limits of single-policy solutions, and the margins through which fiscal reforms can affect growth and fiscal trajectories.

The remainder of this paper is organized as follows. Section 2 examines the relationship between Japan's accumulated public debt in a macroeconomic framework. It argues that the deterioration of Japan's public debt position during the 1990s was largely driven by expansionary fiscal policies implemented as macroeconomic stimulus, particularly through extensive public works programs.

From the early 2000s onward, the primary source of persistent fiscal deficits gradually shifted from discretionary fiscal measures toward rising social security expenditures. Section 3 focuses on the expenditure side of the government budget and explores the interaction between the government fiscal situation and population aging. The section surveys quantitative macroeconomic models that analyze the linkage among the social security system, household behavior, and the macroeconomy in Japan in the context of ongoing demographic change.

Section 4 shifts attention to the revenue side of the government budget and analyzes fiscal sustainability through labor market dynamics, which are central to maintaining production and tax revenues. While a resilient revenue base is essential for addressing the accumulated public debt problem, Japan is expected to face a sustained decline in the working-age population. This section reviews policy analyses relevant to the sustainability of Japan's labor force, including labor force participation among the elderly and women, the inflow of foreign workers, and policies aimed at supporting family formation. Section 5 concludes by synthesizing the preceding discussion and outlining directions for future research.



(a) GDP Growth Rate (b) Public Debt to GDP Ratio

Fig. 1 GDP and Fiscal conditions . Sources: Cabinet Office of Japan (National Accounts) and OECD (Government Finances and Public Sector Debt)

2 Fiscal policy and sustainability of public debt

This section reviews macroeconomic literature on the accumulation and sustainability of Japan's public debt, focusing on how fiscal policy, institutional features, and economic growth interact to shape debt dynamics. Section 2.1 documents the historical evolution of public debt since the postwar period, emphasizing the role of countercyclical fiscal policy following the collapse of the asset price bubble in the 1990s. Section 2.2 surveys approaches based on the government budget constraint and accounting frameworks, assessing debt sustainability through primary balances, interest–growth differentials, and tax capacity. Section 2.3 turns to neoclassical general equilibrium models, which explicitly incorporate household behavior, fiscal policies, and government borrowing to evaluate the magnitude of fiscal adjustments required to sustain the current fiscal system. Finally, Sect. 2.4 reviews the literature on optimal public debt and sovereign debt, discussing normative benchmarks for debt levels as well as theoretical frameworks that allow for default and fiscal limits.

2.1 A short history of public debt in the Japanese economy

Immediately after World War II, the issuance of deficit-covering bonds (*akaji-kokusai*) in Japan was restricted, and only construction bonds (*kensetsu-kokusai*) allocated to public works projects were permitted. As shown in Fig. 1a, during the high-growth period from 1955 to 1973, tax revenues increased sufficiently in line with GDP, allowing the government to maintain a balanced budget until 1973.[1] When economic growth slowed following the first oil shock shock in 1973, tax revenue growth could no longer keep pace with GDP growth, leading to the issuance of deficit-covering bonds beginning in 1975. However, partly owing to the economic boom associated with the asset price bubble in the late 1980s, Japan was able to return to a balanced budget in 1990.[2]

[1] Deficit-covering bonds were issued only exceptionally in 1965 due to the severe recession following the Tokyo Olympics.

[2] For more detailed description of the evolution of the postwar Japanese economy, including fiscal conditions, see, for example, Ito and Hoshi (2020).

Following the collapse of the asset price bubble around 1990, Japan entered a prolonged period of economic stagnation (the so-called "Lost Decades"), with fiscal deficits in the 1990s driven primarily by expansionary fiscal policies aimed at stimulating economic activity.[3]

With the collapse of the asset price bubble in the early 1990s, the Japanese economy began a sustained downward trajectory. Immediately after the bubble burst, the downturn was regarded as a normal and temporary recession. Consequently, economic recovery became the top priority, and conventional countercyclical measures, both fiscal and monetary, were deployed extensively.[4,5]

In the early 1990s, the government sought to avoid renewed reliance on deficit-covering bonds and succeeded in keeping their issuance at zero between 1991 and 1993 (Nakajima, 2013). However, as the recession proved persistent, the government shifted course and implemented a series of large-scale stimulus packages financed by fiscal deficits. Doi and Ihori (2002) argue that strong political demand for fiscal stimulus reflected the need to support local economies through public works projects (*kokyo-jigyo*) and associated income transfers. Nevertheless, estimates by Watanabe et al. (2008) suggest that the macroeconomic effects of these policies were limited, and Japan continued to experience low growth throughout the post-1990 period. During the 2008 global financial crisis, many advanced economies, including Japan, adopted coordinated fiscal stimulus measures, which heightened concerns about rising public debt, particularly in countries such as Greece.[6] Auerbach and Gorodnichenko (2017) document a decline in fiscal multipliers in Japan in recent years, suggesting that public debt accumulated while the stimulative impact of fiscal policy weakened.[7]

Japan's public debt has increased almost monotonically since the 1990s, with the gross debt-to-GDP ratio exceeding 100% in the late 1990s and approaching 250% by 2020 amid the COVID-19 pandemic (Fig. 1b). However, partly due to the Bank of Japan's zero interest rate policy and large-scale quantitative easing, both short- and long-term interest rates on Japanese government bonds remained persistently low and

[3] This survey does not directly cover the literature investigating the cause of the long economic stagnation and "lost decades" in Japan. See, for example, Hayashi and Prescott (2002), Caballero et al. (2008), and Kobayashi and Ueda (2022). A recent paper by Hayashi (2025) argues that rapid population aging, through a negative age-composition effect on total factor productivity (TFP) growth, is the fundamental cause of Japan's three-decade stagnation. Braun and Ikeda (2025b) show that demographic aging can generate secular stagnation by depressing the interest rate and creating persistent deflationary pressure, limiting the effectiveness of monetary policy and contributing to higher public debt.

[4] Whether fiscal policy is effective has long been debated in economics. Under the Ricardian equivalence proposition, fiscal policy is ineffective when economic agents are rational and fully rational and internalize future tax liabilities (Barro, 1974, 1979). In contrast, a large empirical literature finds positive effects of fiscal stimulus (Auerbach & Gorodnichenko, 2017, Miyamoto et al., 2017, among others). More recently, the presence of heterogeneous agents and non-Ricardian consumers has been shown to amplify fiscal multipliers, potentially enhancing the effectiveness of fiscal policy [see among others, Oh and Reis (2012), Mckay and Reis (2016), Bayer et al. (2019), Bilbiie (2020), Bhandari et al. (2021)]. For the implications of heterogeneity for monetary policy, see Kaplan et al. (2018) and Mian et al. (2021).

[5] For the recent history of monetary policy in Japan and the literature review, see Aoki and Ueda (2025).

[6] On sovereign debt crises and their relationship with financial crises, see Reinhart and Rogoff (2009), who conducted a detailed analysis based on data from various countries worldwide and historical episodes.

[7] For evidence on the effects of fiscal policy in other countries, particularly the U.S., see Barro and Redlick (2011) and related studies.

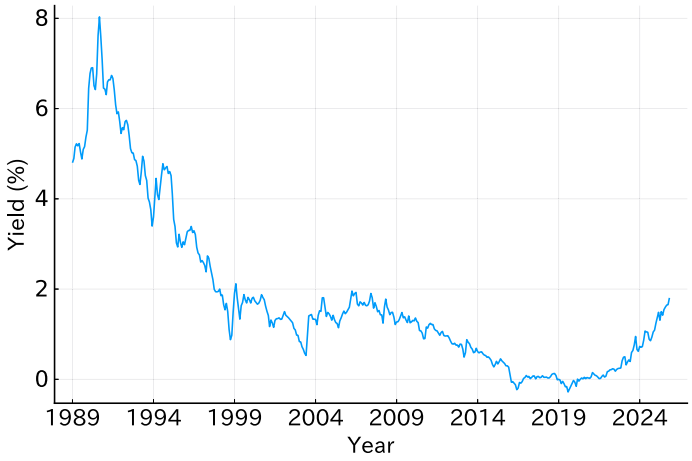


Fig. 2 10-Year Japanese Government bond yield. Source: Federal Reserve Bank of St. Louis (FRED), OECD

stable until around 2024, as shown in Fig. 2. As a result, the accumulation of public debt did not pose immediate financing pressures.[8]

2.2 Sustainability of public debt: approaches from the government budget

Despite implementation of successive fiscal stimulus packages in the 1990s, Japan failed to escape prolonged economic stagnation even into the 2000 s. As public debt continuing to accumulate, the sustainability of Japan's fiscal position became the subject of extensive debate. Broda and Weinstein (2005) is an influential early study that examined Japan's fiscal sustainability at a stage when public debt was still in the process of accumulating. After deriving the conditions under which the net debt-to-GDP ratio would stabilize within a finite horizon, they calculated the permanent tax revenue-to-GDP ratio required to stabilize the debt ratio. They concluded that Japan's fiscal situation "as of 2002" was sustainable, since the implied tax rate of 35–40% was not particularly high relative to contemporaneous levels in Western countries such as the U.S (around 35%) or European countries (around 40%).

However, extending the methodology of Broda and Weinstein (2005) to data through 2010, Doi et al. (2011) argue that maintaining fiscal sustainability had become substantially more difficult following the deterioration of Japan's fiscal position. This finding suggests that fiscal conditions worsened rapidly in the years immediately after the period analyzed by Broda and Weinstein (2005). Moreover, applying the debt sustainability tests proposed by Bohn (1998), they point to the possibility of explosive

[8] Blanchard (2019) and Sudo and Takizuka (2018) argue that low growth and low interest rates have emerged simultaneously in many advanced economies, including Japan, reflecting demographic trends such as declining birthrates and population aging.

debt dynamics, noting that no systematic improvement in the primary balance was observed even as debt levels increased.[9]

In contrast, Hoshi and Ito (2014) focus on the continued stability of Japanese government bond (JGB) prices, reflected in persistently low interest rates, despite extremely high levels of public debt. They document that JGBs have been held stably over long horizons by domestic investors, including private banks, insurance companies, and large institutional investors including the Government Pension Investment Fund (GPIF), and argue that this strong bias has contributed to bond price stability. At the same time, they caution that bank deposits in Japan ultimately depend on domestic savings, implying that continued absorption of government bonds at the existing pace will eventually exhaust domestic saving capacity. Once this limit is reached, government bonds would need to be absorbed by foreign investors, leading them to conclude that Japan's fiscal position is ultimately unsustainable. Similarly, Oshio and Oguro (2013) emphasize the role of low interest rates, warning that fiscal sustainability is at risk because the "low interest bonus" arising from refinancing high-interest legacy debt at lower rates cannot persist indefinitely. More recently, Eguchi and Hatano (2022) estimate the probability distribution of Japan's debt-to-GDP ratio in 2030 using the framework of Blanchard (2019, 2023), focusing on the relationship between the interest rate r and the economic growth rate g.[10] Their estimation results suggest that, if the fiscal rule governing the responsiveness of the primary balance to public debt is sufficiently weak, there is a non-negligible probability that the debt-to-GDP ratio exceeds 250%, or even 300%, by 2030.

Chien et al. (2023, 2025) offer a distinct perspective on the sustainability of Japan's public debt. As discussed above, Japanese government bonds are predominantly held domestically, with particularly large holdings by the Bank of Japan through quantitative easing and by the public pension fund. They therefore argue that fiscal sustainability should be evaluated using the balance sheet of the consolidated government, which includes central and local governments, the Fiscal Investment and Loan Fund (FILF), public pension funds, and the Bank of Japan, rather than just the central and local governments alone. While gross public debt exceeds 200% of GDP, the consolidated government's net liabilities, after netting out holdings by the Bank of Japan and other public entities, amounted to only 77.6% of GDP as of 2024Q2.[11] Moreover, the consolidated government holds substantial long positions in risky, long-term assets such as foreign securities and domestic equities, financed by borrowing at very low floating interest rates. They argue that this portfolio structure has been a key factor in restraining the growth of net public debt.

[9] Several approaches have been proposed to assess the sustainability of public debt, among which the framework developed by Bohn (1998) is one of the most widely used. This approach tests whether fiscal policy responds to rising debt in a stabilizing manner by examining the statistical properties of fiscal deficits. However, it is largely atheoretical, focusing on the stability of fiscal variables without explicit microeconomic foundations. In practice, primary balances, government expenditures, and tax revenues are endogenous, and both governments and individuals are likely to adjust their behavior when fiscal conditions deteriorate.

[10] On the relationship between r and g and the conditions under which perpetual debt rollover may be feasible, see also Kocherlakota (2023).

[11] The choice of debt measure—gross debt, net debt, or consolidated net liabilities—significantly affects assessments of fiscal sustainability and remains debated in the literature.

2.3 Sustainability of public debt: neoclassical models

In the aforementioned studies, fiscal sustainability is typically assessed primarily through the lens of the tax system, the primary balance, and the government budget constraint. However, fiscal sustainability is inherently linked to household behavior, including decisions regarding consumption, savings, and labor supply. Because these behaviors respond endogenously to fiscal policy and feed back into wages, interest rates, and tax revenues, a general equilibrium framework is essential for a comprehensive assessment of fiscal sustainability in the macroeconomy.

Hansen and İmrohoroğlu (2016, 2023) quantitatively analyze fiscal sustainability in Japan by extending the canonical RBC model of the Hayashi and Prescott (2002) type.[12] In Hansen and İmrohoroğlu (2016), after calibrating the model to the Japanese economy and incorporating public debt and the public health insurance system, the authors numerically compute the level of tax rates required to stabilize the public debt trajectory. They find that a substantial additional adjustment on the order of 30% would be necessary in either the consumption tax or labor income tax. Meanwhile, Hansen and İmrohoroğlu (2023) document that the debt-to-GDP ratio stabilized at around 120% between 2011 and 2019, attributing this outcome to expenditure restraint, rising tax revenues, and large-scale government bond purchases by the Bank of Japan. They argue that because interest income on government bonds held by the BoJ is rebated to the government, the effective interest burden is reduced, contributing to this temporary stabilization. Nevertheless, they project that this stabilization will not persist and that, absent further tax increases, the debt-to-GDP ratio will resume its upward trajectory, reaching approximately 250% before 2040. Taken together, these numerical exercises suggest that while Japan's public debt may be sustainable in principle, achieving such sustainability would require imposing extremely large fiscal burdens.

A common counterargument to these analysis is that sufficiently high economic growth could alleviate the debt burden. Indeed, faster economic growth mechanically reduces the debt-to-GDP ratio. This raises the question: what rate of economic growth would be required to stabilize Japan's public debt? İmrohoroğlu and Sudo (2011) examine whether debt reduction could be achieved through TFP growth and concluded that repayment would require an unprecedented average annual TFP growth rate of 6% sustained over a decade, rendering a growth solution "extremely unrealistic."

2.4 Sovereign debt, default, and optimal public debt

While accumulating unsustainably high levels of public debt is undesirable, this does not necessarily imply that reducing public debt to zero is optimal.[13] Since Barro (1974), discussions of Ricardian equivalence have emphasized that public debt merely shifts future tax liabilities forward in time and does not affect the allocation of resources in the

[12] While public debt has accumulated in Japan, Japanese government bond prices have remained stable and interest rates have stayed low. To theoretically explain this phenomenon, Hansen and İmrohoroğlu (2016, 2023) directly incorporate government bond holdings into the utility function. In contrast, Sakuragawa and Hosono (2010) address the issue by introducing intermediation costs.

[13] Eichengreen et al. (2021) discuss the positive roles of public debt based on historical analysis.

economy. In practice, however, government bonds play an important role in providing liquidity and safe assets in financial markets. This naturally raises a fundamental question: what level of public debt is socially desirable?

A seminal study addressing this question is Aiyagari and McGrattan (1998). They analyze the macroeconomic effects of public debt in an economy with heterogeneous agents á la (Aiyagari, 1994). In an incomplete markets framework with idiosyncratic income risk and borrowing constraints, they quantitatively demonstrate that the optimal level of government debt is positive, because public debt serves as an insurance and liquidity instrument for households. Their results imply an optimal debt level of roughly two-thirds of GDP, which was close to the actual U.S. debt level at that time.[14]

Using an approach similar to these papers, Nakajima and Takahashi (2017) analyze the optimal level of public debt in the Japanese economy. They find that the then-prevailing public debt-to-GDP ratio of approximately 130% substantially exceeded the welfare-maximizing level, implying a welfare loss equivalent to about 0.19% of lifetime consumption relative to the optimum. Moreover, drawing on Flodén (2001) as a benchmark, they report that while optimal public debt is around 150% of GDP under U.S. parameters, the corresponding optimal level for Japan implies negative government debt, or "government savings" of about 50% of GDP. This difference arises because the idiosyncratic income risks is relatively low in Japan and existing public systems already provide sufficient insurance, reducing the importance of the insurance effect of public debt.[15] Nakajima and Takahashi (2020), in a study of the U.S. economy, analyze the role of consumption taxes and transfers as insurance against idiosyncratic risk. In an appendix exercise calibrated to Japan, they examine the effects of a policy combination that raises consumption taxes and increases lump-sum transfers, finding that such policies reduce capital-income ratios and consumption inequality when labor supply is divisible but have limited effects when labor supply is indivisible.

The studies reviewed in this and the preceding sections rely on general equilibrium models. A key advantage of this approach is that it allows for a unified analysis of macroeconomic equilibrium while explicitly accounting for microeconomic household behavior, particularly their saving decisions. At the same time, by construction, these models abstract from situations in which the government is unable to repay its debt, that is, they rule out sovereign default in equilibrium. In this sense, they can be viewed as reverse-engineering the conditions required for fiscal sustainability under the maintained assumption that government debt remains payable.

Of course, the assumption that government debt is always repayable does not necessarily hold in practice. History provides numerous examples of sovereign debt defaults across countries. As emphasized by Reinhart and Rogoff (2009), the concept of default itself is ambiguous. Defaults need not involve outright repudiation.

[14] Extending this framework to a lifecycle model, Peterman and Sager (2022) highlight the importance of the mechanism through which public debt, interpreted as public saving, suppresses interest rates and facilitates the smoothing of consumption and leisure over the life-cycle. Calibrating the model to the U.S. economy, they find that optimal public debt is approximately 168% of GDP. Ino and Kobayashi (2022) review how incorporating lifecycle features may alter conclusions about optimal public debt in Japan.

[15] Using a completely different approach based on a life-cycle model with endogenous fertility, Okamoto (2025) analyzes Japan's optimal government debt ratio. Although the approach is quite different, the conclusion is similar: the optimal debt-to-GDP ratio is negative (i.e., the government should hold net assets), implying that the current level of debt is excessively high.

When partial defaults such as debt rescheduling or "de facto repayment" through episodes of high inflation are included, sovereign default emerges as a broad and recurring phenomenon. High levels of government debt can also be reduced in real terms through inflation financing. Although we do not survey this literature in detail, historical precedents abound. At the end of World War II, Japan's public debt reached extraordinarily high levels. Under exceptional postwar economic conditions in the late 1940s, Japan experienced hyperinflation, with annual inflation rates reaching several hundred percent, which sharply reduced the real value of outstanding government debt. A well-known earlier example is the hyperinflation in Germany in the early 1920s, where postwar fiscal imbalances combined with monetary expansion led to a collapse in the real value of public debt.

Understanding why sovereign debt defaults occur and through which mechanisms is inherently challenging. Unlike individuals or corporations, whose default incentives are disciplined by legal penalties, governments face no supranational authority that enforces debt repayment. Nevertheless, governments typically take actions to avoid default. Modern research on sovereign debt and default began with Eaton and Gersovitz (1981) and Bulow and Rogoff (1989), and has since developed into a large literature. Aguiar and Amador (2014, 2021) analyze sovereign debt and default from the perspectives of reputational punishment and limited commitment.[16]

In contrast, Japan's experience with government debt presents two puzzles in light of the sovereign debt crisis literature.[17] The first puzzle is that the risk of sovereign debt crises driven by multiple equilibria or self-fulfilling expectations is predicted to arise at debt-to-GDP ratios far below Japan's current level. One possibility, as suggested by Chien et al. (2023), is that the definition of the debt-to-GDP ratio used in standard models may not be well suited to the Japanese economy, and that the analysis should instead adopt a definition based on the consolidated government. That is, markets may be assessing risk by taking into account not only Japan's high debt ratio but also the assets held by those who hold the debt. A second puzzle concerns why JGB yields and inflation did not rise sufficiently in response to the elevated default risk. It is natural to expect that heightened risk would be reflected in higher interest rates and inflation. Braun and Nakajima (2016) offer an explanation for this puzzle. They argue that market frictions, rather than pure fundamentals, can delay increases in the interest rate and account for the late surge in sovereign spreads. Hansen and İmrohoroğlu (2016, 2023) address the question of why JGBs are held despite low returns by directly incorporating preferences for government bond holdings into the utility function.

In Sect. 3.2.1, we revisit the sustainability of government debt in Japan using a life-cycle model, linking the analysis to the demographic challenges of population aging and the social security reforms that Japan faces.

[16] As a distinct alternative, the literature on optimal fiscal policy under a Ramsey planner has examined optimal debt dynamics. Building on Lucas and Stokey (1983) and Aiyagari et al. (2002), Bhandari et al. (2017) find that the optimal long-run target for government debt in the U.S. is negative but close to zero.

[17] See, for example, Arellano (2008), Cole and Kehoe (2000), and Aguiar et al. (2013).

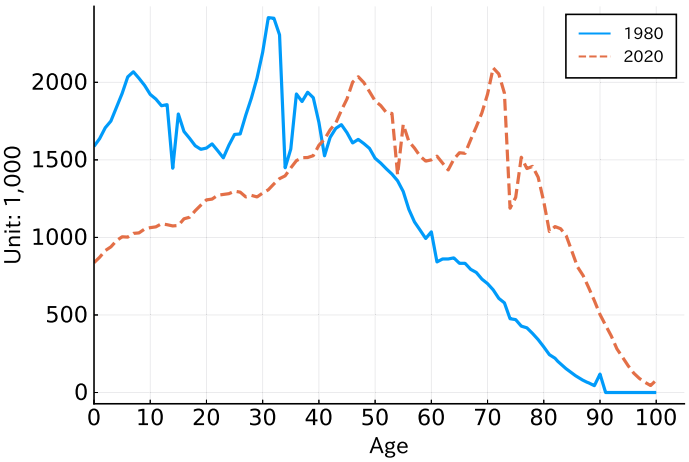


Fig. 3 Population distribution in Japan: 1980 vs 2020

3 Demographic aging and fiscal expenditure

This section focuses on the expenditure side of the government budget and explores the roles of demographic aging and how it has become a central driver of Japan's debt accumulation through its interaction with the social security system. As the source of persistent fiscal deficits has shifted since the 2000s from discretionary fiscal stimulus to age-related social security expenditures, understanding debt dynamics requires explicit modeling of population structure, age-dependent government transfers, and household behavior over the life-cycle. This section therefore focuses on the studies that use quantitative overlapping generations (OLG) frameworks that connect demographic change to macroeconomic and fiscal outcomes. Section 3.1 introduces the literature that employs OLG modeling approaches, demonstrating that the framework is particularly well suited for analyzing aging societies and the macroeconomic effects of social insurance systems. Building on this framework, Sect. 3.2 reviews the literature that applies OLG models to Japan's institutional setting with a particular focus on the three pillars of the social security system in Japan: public pension system, health insurance, and long-term care insurance programs.

3.1 Overlapping generations economies

The main cause of Japan's accumulated public debt in the 1990s was expansionary fiscal policy aimed at economic stimulus, particularly through public investment. Subsequently, however, the primary driver of the debt problem shifted from discretionary fiscal policy to social security-related expenditures. The share of public works spending in general account expenditures, which stood at around 10 percent during the 1990s, has fallen by half to approximately 5.3 percent in fiscal year 2025. This shift reflects Japan's rapidly declining birthrate and aging population.

As Fig. 3 shows, Japan had a large working-age population in the 1980s, with baby

boomers in their 30s and relatively few retirees. By contrast, by 2020 the baby boomers had largely retired, while the size of younger cohorts had declined substantially.

Japan introduced universal public pension and universal health insurance systems in the 1960s, thereby establishing a comprehensive social security system. At that time, the labor force was abundant and the proportion of elderly individuals was low. As a result, there were few concerns regarding the sustainability of the public pension system, which operates primarily on a pay-as-you-go basis.[18] Similarly, the health insurance system remained stable, as medical expenditures grew only modestly due to the small elderly population. However, with the subsequent rapid aging of the population and persistent decline in fertility, social security-related expenditures began to rise sharply. The introduction of the long-term care insurance system in 2000 further accelerated the growth of social security spending associated with population aging.

The OLG model is a natural macroeconomic framework for analyzing demographic dynamics, social security reforms, and other fiscal issues. Since the seminal contributions of Samuelson (1958) and Diamond (1965), a vast literature has developed using OLG models across a wide range of applications. Even when restricting attention to fiscal policy and demographics, the literature is too extensive to be surveyed comprehensively.[19] Among this body of work, the pioneer work preceding the papers reviewed in this survey is the life-cycle general equilibrium model with multi-period living economic agents by Auerbach and Kotlikoff (1987). Earlier models typically assumed that agents lived for only two or three periods and relied primarily on analytical solutions. By contrast, Auerbach and Kotlikoff (1987) employed numerical methods to analyze the consumption and saving behavior of agents living for multiple periods, thereby enabling quantitative macroeconomic analysis within a general equilibrium framework.

The Auerbach and Kotlikoff (1987)-type OLG model, calibrated to U.S. economic parameters, has since been extended in numerous directions and widely applied to the analysis of social security reform and demographic change. An early and influential contribution is Huang et al. (1997), which uses this framework to quantitatively evaluate a policy that temporarily expands public debt in exchange for eliminating social security system. De Nardi et al. (1999) analyze the fiscal implications of the retirement of the baby boomer generation in the U.S. Subsequently, a large number of studies including (Altig et al., 2001; İmrohoroğlu & Kitao, 2012; Kitao, 2014; Kotlikoff et al., 2007; Krueger & Ludwig, 2007; McGrattan & Prescott, 2017; Nishiyama & Smetters, 2005, 2007), have employed large-scale OLG models to study social security reform and demographic developments in the U.S. economy. More recently, Auclert et al. (2024) examine the relationship between global imbalances and country-specific demographic dynamics by combining population projections from 25

[18] More precisely, Japan adopts a system known as a "modified funded system." Under a pure pay-as-you-go system, the government holds no reserve funds, whereas in Japan a portion of insurance premiums has been accumulated as reserves, which are now managed by the Government Pension Investment Fund.

[19] For theoretical properties of OLG models, see, for example, Bewley (2007) and Tvede (2010). León-Ledesma et al. (2026) also provide a review of quantitative studies using life-cycle models focused on public pension, health insurance and long-term care insurance system.

countries with household survey data, and analyze the effects of population aging on wealth accumulation and GDP.

On the one hand, the general equilibrium approach based on overlapping generations models is well-suited for quantitative evaluation of macroeconomic effects associated with policy changes, as it can account for the optimization of household consumption, savings, and labor supply. On the other hand, as mentioned in Sect. 2.4, there is a constraint that only sustainable equilibrium paths can be analyzed. Additionally, since solving household optimization problems numerically is computationally costly, the model structure often has to be simplified. Therefore, some studies also use partial equilibrium approaches to analyze the impacts of social security system reforms.

İmrohoroğlu et al. (2016, 2017, 2019) analyze the impacts of Japan's social security system reforms using a partial equilibrium approach. İmrohoroğlu et al. (2016) simplify household consumption and savings decisions by assuming factor prices such as interest rates and wages to be constant, and adjusting the household lifecycle savings and consumption paths to match the lifecycle profiles observed in actual Japanese data. Meanwhile, they construct a framework for projecting Japan's long-term government debt by modeling the government budget constraint along with the existence of public pension funds, gender differences, occupations (regular employment, nonregular employment, and self-employment), and the macroeconomic slide, which is Japan's unique mechanism for balancing the government's long-term budget. Based on their analysis, net government debt does not stabilize under the current system and is shown to exceed 1000% by 2100. Naturally, considering the equilibrium in the government bond market, bond prices would be expected to collapse before reaching such levels, but if such market adjustment mechanisms do not function, the current system cannot stabilize government debt. In particular, the impact of interest payments on government bonds is substantial, with projections showing that half of borrowing will be directed toward interest payments by 2100. Since such a situation is naturally considered unsustainable, they examine reform proposals such as extending the retirement age to 70, reducing public pension benefits by 10%, and strengthening taxation on labor income. They also consider policies to raise the consumption tax to 20% and utilize the female labor force. While these policies have certain effects, they conclude that it is impossible to stabilize the public debt-to-GDP ratio with any single policy, and that multiple policies need to be combined. İmrohoroğlu et al. (2017) use a similar approach to quantitatively analyze attempts to improve public finances by accepting guest workers from abroad. While such policies have the effect of reducing fiscal pressure by up to about 10% in consumption tax equivalent terms, they show that public finances will still continue to deteriorate through 2100.

3.2 Social security system in Japan

The advantage of the Auerbach and Kotlikoff (1987)-type overlapping generations (OLG) model is that, despite reduced analytical tractability, it allows researchers to incorporate realistic institutional features and derive quantitative implications. Accordingly, numerous studies have examined the effects of Japan-specific institutions. In

particular, a large body of research has analyzed Japan's declining fertility and population aging, together with the associated challenges for fiscal sustainability, as these issues are both quantitatively important and well suited to OLG modeling.

As noted earlier, the primary source of fiscal pressure in Japan today is the rising burden of social security expenditures driven by demographic change. Japan's social security system consists of three main pillars.

The first pillar is the public pension system. Universal pension coverage was achieved in the early 1960s, and all residents aged 20–59 are required to enroll in the National Pension (*Kokumin Nenkin*), which provides flat benefits after retirement. In addition, employees participate in an earnings-related pension scheme, the Employees' Pension (*Kosei-Nenkin*). Since most workers are employees, a large share of the population is covered by this two-tier public pension system. Self-employed individuals, freelancers, unemployed persons, and students are enrolled only in the National Pension.

The second pillar is the public health insurance system. Its institutional framework was also established in the early 1960s, and universal enrollment is mandatory. Employees are covered through employer-based insurance, whereas the self-employed and unemployed enroll in National Health Insurance. The system covers most medical expenditures, with patients paying a portion of medical costs as a co-payment. Individuals under age 70 pay 30% of medical costs, while those aged 75 and above typically pay 10%, with higher-income elderly facing higher co-payment rates.[20] Japan is known for high life expectancy exceeding 80 years for both men and women, and this, in part, reflects the effectiveness of its health care system. However, population aging has led to rising medical expenditures, which have become an increasing important source of fiscal strain.

The third pillar is the Long-term Care Insurance (LTCI) system. Introduced in 2000 in response to growing social concerns over elderly care in the 1990s, LTCI requires enrollment for all individuals aged 40 and above. The system provides care services to elderly individuals who receive official care-needs certification. As with health insurance, expenditures of LTCI have increased substantially due to demographic aging, further intensifying fiscal pressures.

Both health insurance and long-term care insurance operate largely on a pay-as-you-go basis, with expenditures for the elderly financed primarily through premiums paid by the working-age generation and supplemented by tax revenues. The resulting increase in the burden on the working-age generation has become a central driver of Japan's public debt accumulation.

All three pillars play crucial roles in Japan's social security system. As demographic aging continues and the need for reform intensifies, a growing literature has examined these institutions from multiple perspectives. In what follows, we survey quantitative macroeconomic research based on overlapping generations models, focusing on fiscal policy and reform of the social security system.

[20] More precisely, co-payment rates for the elderly vary by income, and high-income elderly face rates comparable to those of the working-age population.

3.2.1 Fiscal burdens and social security reforms

The public pension system accounts for the largest share of Japan's social security expenditures and plays a central role in the accumulation of public debt. Japan's pension system operates under a modified funded system, with the accumulated reserves managed by the Government Pension Investment Fund (GPIF). However, these reserves were largely built up before the rapid progression of demographic aging, and the system operates essentially on a pay-as-you-go basis, with reserves serving as a supplementary buffer.

As discussed in Sect. 3.1, a vast literature examines the design and financing of public pension systems and their effects on labor supply and savings decisions. In this section, we focus on quantitative macroeconomic studies.[21]

The urgency of pension reform in Japan has intensified as demographic aging accelerates and public debt continued to rise. Quantitative macroeconomic studies using OLG models highlight the intricate interactions between pension parameters, labor supply, savings behavior, and fiscal sustainability. A central conclusion emerging from this literature is that no single reform instrument suffices to restore long-run fiscal balance. Rather, comprehensive policy packages and combinations of policies are required to stabilize the debt trajectory.[22]

Braun and Joines (2015) analyze fiscal sustainability in rapidly aging Japan using a large-scale OLG general equilibrium model with detailed modeling of the social security system, health insurance, long-term care insurance, and demographic structure. They document that government debt rose from 8 percent of GDP in 1990 to 150 percent in 2012. They project that, even after incorporating the 2004 pension reform and consumption tax increases to 10 percent, Japan would face a severe sovereign debt crisis by 2039 absent further adjustments. Importantly, they emphasize that the primary driver of long-run fiscal imbalances is the projected growth in public medical and long-term care expenditures rather than public pension spending. Stabilizing debt would require extraordinarily large fiscal changes. Immediate adjustment would imply raising the consumption tax to 36 percent, while gradual implementation would require an even higher peak rate of 46 percent around 2100. They also argue that reducing pension benefits by 10 percent would weaken labor supply incentives by attenuating the link between contributions and future benefits, and therefore suggest that increasing cost-sharing in medical expenditures may be a more effective instrument for fiscal consolidation.

Using a similarly detailed OLG framework, Kitao (2015) examines the fiscal and welfare consequences of maintaining current pension, health and long-term care systems under rapid aging and declining fertility. She estimates that sustaining current

[21] See, for example, De Nardi et al. (2001) for an early survey of pension reform analyzed within general equilibrium OLG frameworks. Early quantitative studies of U.S. public pension reform include (Conesa & Krueger, 1999; De Nardi et al., 1999), and Nishiyama and Smetters (2005, 2007), which extend the Auerbach and Kotlikoff (1987) framework to incorporate additional elements including idiosyncratic risks and borrowing constraints. Fuster et al. (2003) further extend this class of models to allow for two-sided altruism when evaluating welfare effects of public pension reforms in the U.S.

[22] Early OLG-based analysis of aging Japan include (Kato, 1998, 2002). Reflecting the policy concerns of their time, these studies focus less on debt sustainability and more on economic growth and social infrastructure investment.

benefit levels would require the consumption tax rate to peak at 48 percent in the late 2070s to balance the government budget. This reflects a projected old-age dependency ratio (population aged 65 and above relative to those aged 20–64) of 85 percent by 2050, which substantially raises age-related expenditures, while shrinking the tax base. Expressing fiscal burdens in consumption-tax equivalents underscores the distortionary effects of labor income taxation. Financing adjustments through labor taxes would significantly reduce elderly labor supply and capital accumulation, and may even preclude the existence of a competitive equilibrium.

Importantly, the above two papers do not advocate exclusive reliance on the consumption tax. Rather, the consumption-tax-equivalent rate serve to illustrate the quantitative magnitude of the required fiscal adjustment. Determining the optimal mix of labor, consumption, and other taxes remains an open question. Mcgrattan et al. (2021) uses an OLG model calibrated to Japan and compare alternative policy options to finance the demographic transition. They argue that gradual increases in the consumption tax deliver stronger macroeconomic performance and higher welfare for most individuals than the other financing options considered.

Okamoto (2013, 2025) extend the approach to evaluate alternative social security reforms in Japan, examining not only fiscal effects but also welfare implications. Kitao (2017, 2018) further emphasize the importance of reform timing. Early implementation reduces the burden on future generations and supports higher wages. By contrast, when policy uncertainty regarding the content and timing of reform induces precautionary saving, depresses interest rates, and reduces retirement income for the elderly, generating substantial welfare losses. Thus, both delay and prolonged uncertainty about reform undermine intergenerational welfare.

More recently, Yamada (2025) shows that maintaining the current fiscal framework would require a consumption-tax-equivalent rate exceeding 30 percent by 2070. He further examines how Japan's rising capital share interacts with social security reform. An increase in the capital share raises returns to capital holders, who are predominantly older households, thereby stimulating their consumption. These findings suggest that shifts in capital share may interact favorably with fiscal consequences of reform in aging economies.

3.2.2 Medical care expenditures and health insurance

The health insurance system is a central pillar of Japan's social security system alongside the public pension system. Japan established universal public health insurance in the early 1960s, requiring all residents to enroll in some form of public coverage. Employees are insured through employer-based plans, while the self-employed and unemployed enroll in the National Health Insurance system. Dependents including non-employed spouses and children are covered under the policyholder's insurance. Although coverage applies to all age groups, medical expenditures are disproportionately concentrated among the elderly, particularly the old-old and those requiring end-of-life care, making the system highly sensitive to demographic aging. As medical spending rises with population aging, fiscal pressures intensify and the need for health insurance reform continues to grow.

The macroeconomic and fiscal consequences of health insurance systems has been extensively studied internationally, particularly in the context of the U.S. economy. Jeske and Kitao (2009) provide an early quantitative macroeconomic analysis of health insurance reform, incorporating the institutional features of the U.S. system. Unlike Japan's universal and mandatory coverage, the U.S. system relies heavily on private insurance markets, leaving a non-negligible share of individuals uninsured and exposed to substantial medical expenditure risk. Building on this framework, Attanasio et al. (2011) introduce empirically estimated health expenditure risks using the Medical Expenditure Panel Survey (MEPS) data and evaluate the welfare and macroeconomic effects of Medicare as protection against large medical shocks. While not directly addressing fiscal sustainability and demographic aging, French (2005), French and Jones (2011), and De Nardi et al. (2010, 2016) provide influential structural analysis of health risk, saving, and labor supply decisions in the U.S., primarily focusing on household behavior rather than aggregate fiscal outcomes. Hansen et al. (2014) analyze the effects of a Medicare buy-in option for workers aged 55–64, accounting for adverse selection, while Conesa et al. (2018) show that abolishing Medicare would would improve macroeconomic aggregates but reduce overall social welfare, as Medicaid would partially offset fiscal savings while increasing burdens on the elderly.

Given substantial institutional differences between Japan and the U.S., evaluating health insurance reform in Japan requires models that explicitly incorporate Japanese institutional features. Hsu and Yamada (2019) develop an OLG model tailored to Japan's public health insurance system and quantify the fiscal consequences of health insurance reform. Their analysis shows that the rise in medical costs driven by population aging requires an increase of 5.68 percentage points in the labor income tax by 2050 relative to 2013 levels. Their analysis further shows that raising co-payment rates or increasing the consumption tax may improve social welfare, and they assess the political feasibility of reforms using the framework of Conesa and Krueger (1999). Hagiwara (2024) examines health insurance reform focusing on the demand side of medical care utilization. More recently, Fukai et al. (2025) estimate health risks using administrative medical claims data and analyze lifecycle saving behavior under alternative insurance regimes. They find that higher co-payment rates increase savings among the elderly but reduce asset holdings among low-income households, potentially increasing reliance on public assistance (*Seikatsu-Hogo*). While no quantitative macroeconomic study has yet evaluated the fiscal implications of extended welfare assistance in Japan, such spillover effects could significantly affect long-run fiscal sustainability, underscoring the broader policy relevance of health insurance reform.

3.2.3 Long-term care insurance

The third pillar of Japan's social security system is the Long-term Care Insurance (LTCI) system. Japan introduced LTCI in 2000 as a major reform of elderly care policy. The system is primarily financed on a pay-as-you-go basis. Prior to its introduction, long-term care relied heavily on family provision, most often women, placing substantial burdens on households. In addition, insufficient community-based care options led to prolonged hospital stays among elderly individuals with little prospect of recovery, a phenomenon commonly referred to as "social hospitalization," which contributed to

rising medical expenditures. LTCI was designed to address these structural problems by providing in-kind care services based on assessed care needs of elderly individuals.

The system has several defining features: (1) mandatory enrollment for all individuals aged 40 and above; (2) benefits provided primarily in the form of in-kind services rather than cash transfers; (3) eligibility determined according to eight officially certified care-need levels based on standardized functional assessments; and (4) service utilization concentrated among individuals aged 75 and older.

As population aging progresses, long-term care has become an increasingly important policy issue not only in Japan but across advanced economies.[23] In addition to rising medical expenditures associated with deteriorating health in old age, societies face challenges related to securing caregivers for a growing number of elderly individuals living alone and protecting those at risk of dying alone. These issues are particularly salient in Japan, where demographic aging is more advanced with a prolonged low fertility than in most other countries. Braun et al. (2017, 2019) document that in the U.S., although roughly half of 50-year-olds will eventually enter nursing homes and one in ten will face life-time out-of-pocket expenditures exceeding $200,000, private long-term care insurance coverage among individuals aged 62 and above remains low at approximately 10 percent. They analyze the design of long-term care insurance systems in the U.S., incorporating Medicaid and private insurance supply behavior, and show that means-tested social insurance programs such as Medicaid provide substantial insurance value against joint risks of long-term care needs, longevity, and low income. They further find that one-third expansion of such programs would raise aggregate social welfare even after accounting for the distortionary costs of taxation. While Braun et al. (2017) emphasize the compounded risks of being sick, alone, and poor in old age, Capatina et al. (2024) examine long-term care risks and the role of informal care, distinguishing between single-person households and couples.

In Japan, mandatory enrollment of long-term care insurance for all individuals 40 and above largely mitigates severe financial risk. However, when combined with the already substantial costs of public pensions and health insurance, LTCI has significantly increased the contribution burden on the working-age population. Consequently, reform of the LTCI system has become central to debates on fiscal sustainability.

A distinctive feature of Japan's LTCI system, relative to those in many other countries, is the widespread reliance on at-home care, partly reflecting policy design that favors home-based over institutional services. Mikoshiba (2025) distinguishes between home-based and institution-based care and analyzes the fiscal implications of Japan's LTCI system using an OLG model featuring two-sided altruism between parents and children. Incorporating in-kind transfers, which is central to Japan's long-term care insurance system, as well as the presence of caregivers, she conducts a welfare

[23] Barczyk and Kredler (2018); Barczyk et al. (2025) analyze long-term care in the U.S. economy, emphasizing the role of informal care provided by adult children and the strategic interactions between parents and children, including bequest motives such as housing bequests. Similar intergenerational patterns are observed in Japan. Historically, long-term care in Japan has fallen disproportionately women. The introduction of LTCI, by reducing the burden of parental care, has contributed to an increase in female labor supply (Shimizutani et al., 2008; Sugawara & Nakamura, 2014).

evaluation and quantitatively demonstrates the importance of LTCI for fiscal sustainability.[24] Meanwhile, İmrohoroğlu et al. (2019) quantify the fiscal consequences of demographic transition, including long-term care expenditures, and show that LTCI spending is projected to grow more rapidly than public pension and health insurance expenditures towards the end of the century.

4 Demographic aging and fiscal sustainability through the labor market channel

A declining working-age population and the rising share of the elderly pose significant macroeconomic and fiscal challenges, reducing the economy's capacity to produce output and generate tax revenues to support rising expenditures. We focus on the revenue side of the government budget and analyze fiscal sustainability through labor market channels, reviewing the literature on labor market developments in Japan. With fertility well below replacement for decades and longevity continuing to rise, the contraction of the working-age population is largely inevitable over the coming decades, making it essential to understand the channels through which labor supply can be sustained and policies that effectively raise the productivity of scarce labor resources.

Many studies have explored how this demographic transition affects the labor supply decisions of household members and resource allocations of families. Household decisions in turn affect movements of macroeconomic variables including aggregate labor supply, capital, and the population dynamics, affecting required government expenditures and tax revenues. During past decades, we have observed dramatic changes in the duration of working lives, the pattern of female employment, and the presence of foreign workers in the labor market. There have also been shifts in the pattern of family formation, represented by low fertility.

In this section, we survey research on the recent development of the labor market and the demographic transition focusing on four closely related adjustment channels: extending working lives at older ages, increasing female labor force participation, supplementing domestic labor through immigration and the arrival of foreign workers, and influencing fertility and family formation to shape the size of future cohorts. Each channel operates through distinct behavioral mechanisms and policy instruments, affects the economy over different horizons, and interacts with the others through general equilibrium feedbacks. Together, these four margins constitute the feasible set of strategies for maintaining the effective workforce in an aging society. The remainder of the survey proceeds as follows: Sect. 4.1 reviews research on life-cycle labor supply of households, with a special focus on the behavior of older individuals, Sect. 4.2 examines female labor force participation, Sect. 4.3 discusses immigration and foreign workers, and Sect. 4.4 surveys the literature on fertility, marriage, and decisions within a family.

[24] Mikoshiba et al. (2025) estimate the evolution of health status risk in Japan using administrative LTCI claims data.

4.1 Labor force participation over the life-cycle and the elderly

Japan stands out for the exceptionally high and rising labor force participation of older individuals, particularly those in their 60 s and early 70s. This phenomenon has attracted attention in the literature because continued work at older ages is one of the few margins through which Japan can partially offset the decline in its working-age population and maintain the labor force.

Although the population started to decline in the late 2000s due to persistently low fertility rates below the replacement rate since the 1970s, the number of workers has been increasing because of increases in participation rates during the same period. The rise, however, was not uniform across all age groups and genders. Kawaguchi et al. (2021) show that the employment expansion under Abenomics in the 2010s was highly uneven across groups and sectors. The largest gains came from women and older workers, while employment among prime-age men increased only marginally because participation was already high. By age, employment rose most sharply among individuals aged 60 and above, reflecting both strong labor demand and institutional support for continued employment at older ages. By gender, female employment, especially among married women and mothers, accounted for a substantial share of net job growth, though much of it was in non-regular work. By sector, employment gains were concentrated in service industries, particularly health care, long-term care, welfare, retail, and personal services, which disproportionately employ women and the elderly, while manufacturing saw little job growth and construction experienced only temporary increases.

In response to the gradual increase in the pension eligibility age from 60 to 65, Japan revised the Elderly Employment Stabilization Law in 2006. The reform legally required firms to ensure employment for incumbent workers up to the pensionable age, by either raising the mandatory retirement age, abolishing mandatory retirement, or introducing reemployment or employment-extension schemes. In practice, most firms retained the formal retirement age at 60 but rehired workers on new contracts, typically with substantially lower wages, until pension eligibility.

Several papers empirically examine the effect of this regulatory requirement. Kondo (2016) examined the effects of Japan's 2006 law mandating firms to allow employees to work until the pensionable age. The study finds no evidence of crowding-out of young male workers when older men's employment increases. Firms did not reduce hiring of young full-time workers despite keeping more seniors employed. Instead, adjustments occurred via wages, and many firms cut the earnings of employees rehired in their early 60s, especially for cohorts affected by the reform. Some firms slightly reduced middle-aged female part-time positions to accommodate more old workers. Focusing also on the demand side, Kondo and Shigeoka (2017) provide causal evidence that the 2006 Law increased employment among men aged 60–64, with effects driven primarily by firm-side compliance rather than worker-side incentives. Exploiting sharp cohort and firm-level variation in exposure to the mandate, the paper shows that firms adjusted mainly by retaining older workers, often through reemployment schemes.

Empirical studies also emphasize that retirement behavior and labor supply of the elderly are highly sensitive to various institutional features such as pension eligibility

ages, benefit formulas, earnings tests, and mandatory retirement practices. For example, Oshio et al. (2020) document how institutional disincentives, including pension rules and earnings tests, are associated with older individuals' decisions to work and retire. Oshio et al. (2023) extend the empirical analysis with longitudinal data and simulate reforms to quantify their impacts. Nakazawa (2022) shows that raising the public pension eligibility age by one year increases male employment by about 7–8 percentage points, using a regression discontinuity design and large-scale survey data of the cohorts affected by the policy change.

OECD (2018) evaluates how Japan's labour-market institutions, retirement rules, and workplace practices shape employment and productivity at older ages as it goes through rapid demographic aging. It points to Japan's high participation rates of older workers, but argues that better-aligned pension incentives, lifelong skills policies, and job quality reforms are needed to ensure sustainability of long and productive working lives.

There is a line of literature that points to the improvements in the health conditions among old individuals. Usui et al. (2017) estimate health-based work capacity among older individuals in Japan using nationally representative microdata, the Comprehensive Survey of Living Conditions (CSLC). They simulate how much older individuals could work if employment decisions were determined solely by health. The paper shows that a substantial share of older Japanese workers have unused work capacity given their health and places Japan's experience in an international context. Oshio and Shimizutani (2019) estimate the health capacity to work of older Japanese individuals, using the CSLC data from 1986 to 2016. They find that a substantial share of older men and women, especially those in their late 60s and early 70s, have unused work capacity given their health, and also document a clear upward trend in health capacity to work over time, suggesting that population aging in Japan has been accompanied by rising potential labor supply that remains underutilized. Oshio et al. (2024) extend the earlier analysis focusing on a current cross-sectional assessment of unused work capacity among older individuals. They demonstrate heterogeneity of health capacity across individuals and better health among the better educated, and find that part-time employment is prevalent even when health would allow more intensive work, pointing to institutional and labor-market constraints rather than health as the key limitation on older-age labor supply.[25]

Kitao and Mikoshiba (2020) quantify the macroeconomic importance of rising labor force participation among women and the elderly in Japan, showing that increases in work at older ages can substantially mitigate the output and fiscal pressures from population aging. İmrohoroğlu et al. (2019) develop a large-scale accounting model calibrated to detailed Japanese institutional features of the pension, health, and long-term care systems to assess Japan's fiscal sustainability under ongoing population aging. The study finds that a combination of changes including rising participation of old individuals and a boost in female employment and earnings is required to stabilize government debt. The results highlight that adjustments affecting labor market outcomes are essential to avoid unsustainable debt accumulation.

[25] See Gruber and Wise (1999) provide a cross-country analysis of the roles of social-security systems in shaping retirement behavior.

A growing body of quantitative research uses structural life-cycle and overlapping generations models to quantify how reforms of the social security and tax systems, wages of older workers, and cohort-specific productivity trends shape labor supply at older ages, and how these behavioral responses feed back into aggregate output, public finances, and welfare. Rust and Phelan (1997) and French (2005) are early works with an estimated structural life-cycle model to study the roles of retirement incentives of fiscal policies. French and Jones (2011) build a structural retirement model with medical expenditure risk and health insurance, highlighting the effects of the insurance policy on saving and retirement decisions of older individuals.

Some representative works in the context of Japan's demographic transition have been already discussed in Sect. 3.2.1. A recent paper by Kitao and Takeda (2025b) builds a life-cycle model of heterogeneous individuals and analyzes the determinants of elderly employment in Japan. The paper identifies the key roles of social security rules and age-specific productivity in shaping work behavior at older ages. The calibrated model shows that reforms to raise the pension eligibility age and lower replacement rates substantially increase labor force participation among men in their 60 s while inducing greater retirement savings. At the same time, the analysis highlights that aggregate productivity growth can reduce elderly participation through income effects, whereas improvements in elderly-specific productivity such as slower skill depreciation encourage longer working lives.

As also mentioned in Sect. 3.2.1, Braun and Joines (2015) develop a quantitative OLG model to show that Japan's reforms to raise healthcare co-payments for retirees would cause current workers to work more and save more in anticipation of higher out-of-pocket costs in old age. This boost in labor supply and capital formation helps stabilize Japan's debt trajectory. In contrast, relying on debt or delayed taxation without structural adjustments would be unsustainable.

Kitao (2015) builds a model with endogenous labor supply over the life-cycle, including participation decisions at older ages, to evaluate the fiscal consequences of population aging in Japan. The paper shows that elderly labor supply responses play an important role in fiscal sustainability. As longevity rises and the population ages, maintaining current pension rules induces strong incentives for early retirement, shrinking the tax base and sharply raising the required tax rate. The simulation analysis demonstrates that policies that raise the pension eligibility age or reduce pension benefits significantly increase labor supply among individuals in their 60 s, thereby mitigating fiscal pressure through both higher tax revenues and lower pension outlays.

Importantly, these labor supply responses are endogenous and quantitatively large, implying that accounting-style projections may substantially overstate future tax burdens if behavioral adjustments at older ages are abstracted from. The analysis provides a macroeconomic and fiscal rationale for policies that encourage elderly employment, showing that increases in labor force participation at older ages can have large effects on aggregate output and government budgets through a rise in earnings and tax revenues as well as a reduction in social insurance expenditures.

4.2 Female labor force participation

Raising female labor force participation has been a significant shift in the labor market in Japan during the period of rapid population aging. At the same time, Japan is infamous for the large gender gaps in earnings and career progression despite a relatively high level of educational attainment of women and their superior health conditions.

From a macroeconomic perspective, women's labor supply is particularly important because it has substantial implications for long-run growth and fiscal sustainability, and a large potential to boost the effective labor supply given the large gender gap that suggests under-utilization of one-half of the working-age population (Greenwood et al., 2005; Olivetti & Petrongolo, 2016). Kawaguchi and Toriyabe (2022) develop new indices of skill and skill use, by leveraging detailed task-frequency questions from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) and Item Response Theory (IRT). The questionnaires allow them to separate the skills that workers possess from the actual skill usage. They find that the gender gap in skill use is particularly pronounced in Japan where overall gender gaps in wages and career advancement are large, suggesting that Japanese women's cognitive skills are less fully tapped in the labor market compared with men in Japan and with women in some other OECD countries.

It is also known that women respond to a shift in wages and fiscal policies more elastically than men, indicating that incentives embedded in policies may strongly influence their behavior. Kuroda and Yamamoto (2008) estimate labor supply elasticities for Japanese workers and find that male prime-age workers exhibit near-zero elasticities, while female labor supply, especially participation, is substantially more elastic to wages.

Yamada (2011) also finds larger elasticities of labor supply among women. He analyzes the effect of the large income tax reforms implemented in Japan during the 1990s, using panel data from the Japanese Panel Survey of Consumers and exploiting quasi-experimental variation in effective marginal tax rates generated by changes in tax schedules and the spousal allowance system. The paper finds that married women's hours of work respond strongly to after-tax wages, with an elasticity of about 0.8, while labor supply responses of married men and unmarried women are essentially zero. The results imply that Japan's tax system created substantial work disincentives for secondary earners, and that tax cuts during the 1990s induced meaningful increases in married women's labor supply, largely through adjustments in hours rather than participation.

Both the empirical and the structural literature have highlighted that Japan's fiscal and social insurance system embeds unique non-convexities, most notably through special provisions such as spousal deductions, dependent spouses' exemptions from the payment of social insurance premiums, and survivor pension benefits. These provisions may distort participation and career choices of women over the life-cycle and alter women's employment trajectories, human capital accumulation, and as a result, aggregate labor supply and tax revenues.

Kawaguchi et al. (2021) assess Abenomics from a labor market perspective and document that Japan's female labor force participation rose to record levels, driven

by a combination of strong labor demand and structural shifts. They emphasize tight labor markets, expanded childcare availability, growth in service sectors that disproportionately employ women, and changing firm practices that facilitated participation by married women and mothers. As a result, the participation rate for women aged 15–64 increased from about 63% in 2013 to roughly 73% by 2021, surpassing levels in the US and Europe, and the traditional M-shaped age–employment profile has largely flattened. At the same time, the authors note that many of the additional jobs are non-regular positions, and Japan's gender pay gap remains high compared to other OECD countries, implying that further structural reforms, including reducing tax-based work disincentives, are needed to raise women's earnings and fully utilize female labor supply.

Further empirical evidence confirms that tax and social insurance policies in Japan create strong "earnings walls" that distort married women's labor supply. Yokoyama and Kodama (2015) show that the partial abolition of the special spousal deduction raised hours and earnings for low-income married women but accentuated the 1.03 million yen distortion point for others, reinforcing labor supply bunching around that threshold. Furthermore, Yokoyama and Kodama (2018) find that increases in social insurance premiums reduce employment and affect hours decisions, showing how non-wage cost factors interact with tax incentives to shape women's labor market outcomes.

More recently, Kondo and Fukai (2023) use administrative tax records from Japanese municipalities to explore how married women's labor supply is distorted by focusing on kinks and notches embedded in the Japanese tax and social security schedule. The authors document bunching at key income thresholds (e.g., 1.3 million yen below which dependent spouses are exempt from social insurance contributions) and analyze how adjustments to spousal deductions and premium exemptions affect women's reported earnings and labor supply before and after marriage and childbirth. Importantly, the evidence suggests that income targets and tax and social insurance incentives together significantly affect married women's labor supply patterns.

How do these work disincentives in the fiscal system affect the life-cycle behavior of women, their life-time human capital earnings, and aggregate labor supply? Using a structural life-cycle model, Kitao and Mikoshiba (2024) examine how Japan's tax and social insurance systems influence women's employment, career paths, and earnings. The paper focuses on three provisions embedded in the fiscal system: the spousal tax deduction, the social insurance premium exemption for dependent spouses, and generous survivor pensions for widows. They find these fiscal policies significantly discourage married women's labor supply and accumulation of skills.

Model simulations show that eliminating these rules would significantly increase female labor supply and push more women into higher-paying regular jobs. Over the life-cycle, women would accumulate more human capital and enjoy higher wage growth. Importantly, the government would collect more tax revenue from working women, and overall welfare would improve. In short, this study suggests that removing Japan's "second earner" tax penalties and disincentives for growth would unlock a large untapped labor supply of women. The result is in line with findings in the literature that investigates distortionary effects of the fiscal system on the secondary earners in

other countries.[26] Second-earner disincentives and gender employment gaps in Japan are also discussed in OECD (2024a), which points to the persistence of a dual labor market, limiting female labor participation and contributing to gender inequalities in career progression. Akabayashi (2006) estimates a structural model and studies how Japanese married women's labor supply responds to the tax and social security system. He finds that women's labor supply is more responsive to changes in the husband's spousal tax deduction than to their own income tax and that common household models overstate the effects of proposed policy reforms on married women's labor supply.

A dynamic structural model developed by Yamaguchi (2019) accounts for women's employment, fertility, and parental leave decisions, incorporating job protection and cash benefit features of Japan's parental leave policy. The study finds that introducing an initial one-year job protection period increases maternal employment, whereas extending it beyond one year or expanding cash benefits has only modest impacts on employment and little effect on fertility choices, suggesting that while parental job protection can improve female labor market attachment, current parental leave policy parameters are unlikely to substantially raise fertility in Japan.

The literature reviewed in this section consistently finds that Japan's female labor supply is both highly responsive to economic incentives and constrained by institutional features of the current tax, social insurance, and labor market systems. Empirical evidence shows that women, especially married women, exhibit large labor supply elasticities and strong bunching around tax and social security thresholds, reflecting powerful "second-earner" disincentives embedded in fiscal policy. Macro and structural studies demonstrate that these distortions depress lifetime employment, human capital accumulation, and labor supply at the aggregate level. At the same time, the studies imply the substantial potential for further gains in labor supply if policy-induced distortions are reduced and women's career paths are improved. Reforms that target removing disincentives for women are central not only to gender equity but also to Japan's long-run growth and fiscal sustainability, since they would unlock a large and underutilized source of productive labor.

4.3 Immigration and foreign workers

There has been a significant increase in the number of foreign workers in Japan and the continued inflow represents a potentially powerful margin to mitigate the decline in the labor force in Japan over the coming decades. Despite political and institutional constraints that may arise, Japan provides a particularly informative case given its historically low reliance on foreign labor.

In contrast to countries in Europe and North America, Japan has long favored temporary and tightly regulated migration channels, resulting in a foreign-born population share that remains among the lowest among developed countries. OECD (2024b) provides a comprehensive policy review of Japan's recent shift from a highly restrictive immigration regime toward more proactive recruitment of foreign workers in recent years, documenting new visa pathways, sector-specific programs, notably in care,

[26] See, for example, Borella et al. (2023), Guner et al. (2012), and Bick and Fuchs-Schündeln (2018).

construction, and manufacturing, and persistent bottlenecks such as language requirements, employer capacity, and retention. It concludes that while recent reforms have increased inflows and improved matching, Japan's system remains fragmented and short-term oriented, and that sustained labor-market and fiscal benefits require clearer pathways to wage growth, job mobility, and longer-term residence rather than reliance on narrowly targeted temporary schemes.[27]

The macroeconomic literature therefore asks whether, and to what extent, expanded immigration can alleviate labor shortages, sustain economic growth, and improve fiscal balances in the face of rapid population aging. Recent papers also ask whether Japan will be able to keep attracting foreign workers if the wage gap between Japan and major originating countries continues to shrink. Structural OLG and general equilibrium models are well suited to this question, as they can jointly account for the age and skill composition of native and foreign workers, and duration of stay of immigrants, as well as their impact on fiscal balances and shifts in equilibrium wages and interest rates.

An early work by Fehr et al. (2004) analyzes the roles of immigration to alter the fiscal and economic impacts of aging in countries. Although not Japan-specific, the study includes Japan as one of three regions in a global OLG model and reaches a conclusion that even dramatically higher immigration would do little to alter the fiscal and economic impacts of aging in countries like Japan. The authors explain that while more immigrants increase the labor force, they also eventually age and draw benefits, and large inflows could depress wages for native workers. Their model finds that plausible immigration increases, even if skewed toward young high-skilled workers, cannot prevent a steep rise in dependency ratios and associated tax burdens in Japan over the next decades.[28]

İmrohoroğlu et al. (2017) develop a quantitative OLG model with exogenous labor supply, detailed pensions and health spending, and endogenous fiscal policy used to stabilize debt to assess whether temporary guest worker programs can mitigate fiscal stress. Calibrated to Japanese demographics and institutions, the paper compares a baseline transition to alternative paths with guest workers who enter at prime ages, stay for a fixed period, pay taxes but are largely excluded from pensions, and differ in skill levels. Fiscal effects are summarized by the reduction in the consumption tax path needed to keep debt stable. The study finds that realistic guest-worker inflows modestly reduce required tax increases on the order of a few percentage points, with larger gains only under very large or high-skill programs, and that welfare gains for natives are slightly positive.

Relative to İmrohoroğlu et al. (2017), which analyze temporary guest workers in a model without endogenous skill premia, Kitao and Yamada (2021) build an OLG model with explicit skill heterogeneity and traces how immigration alters relative

[27] For a comprehensive survey of the empirical literature on the economic effects of immigration on host countries, see, for example, Borjas (1999). Sasahara (2025) is a recent survey that reviews the impacts of immigration on local labor markets and summarizes the Japanese evidence, highlighting institution-specific responses to migration reforms, and discussing broader channels including population mobility, education and skill formation, and sectoral reallocation.

[28] See also Storesletten (2000) and Busch et al. (2020) for analyses of the role of immigration using quantitative OLG models calibrated to the U.S. and German economies, respectively.

wages, production, and tax revenues. By allowing foreign inflows to differ by skill, the model captures distributional and equilibrium channels. High-skill immigration raises productivity and the tax base more strongly but compresses the skill premium, while low-skill inflows expand employment yet exert downward pressure on low-skill wages. Quantitatively, immigration slows workforce shrinkage and alleviates fiscal pressure, with redistributional outcomes sensitive to the skill mix of entrants. However, even under optimistic, skill-biased inflow scenarios, the improvements fall well short of offsetting demographic aging, echoing the core conclusion of previous studies. Shimasawa and Oguro (2010) develop a multi-country OLG model and show that a permanent and substantial increase in immigration inflows improves the welfare of current and future generations.

Okamoto (2021) explores the optimal design of an immigration policy using a general equilibrium model with endogenous fertility, assuming that a fixed total number of immigrants are admitted. The simulations indicate that a medium-term program of around 9 years of steady immigration maximizes per-capita welfare. A longer immigration period leads to a larger future population and higher long-run economic growth by offsetting population decline, whereas a very short and concentrated inflow gives a more immediate boost but less sustained growth. The medium duration balances these trade-offs, yielding both near-term and long-term benefits.

Recent work by Kitao and Takeda (2025a) endogenizes migration decisions, allowing foreign worker inflows to respond to cross-country wage differentials and demographic trends, thereby providing a more realistic assessment of migration as a policy tool for Japan. The calibrated simulation replicates the recent rapid rise in foreign workers from less than 0.5 million in 2008 to 2.3 million in 2024, and predicts the foreign workforce share will plateau in a few decades mainly due to the shrinking wage differentials between Japan and major originating countries of foreign workers. During the transition, the inflow of foreign workers modestly raises output and helps raise tax revenues, but cannot stop the increase of Japan's old-age dependency ratio nor resolve the fiscal issues.

Overall, Japan has cautiously opened its doors to more foreign workers through various programs such as trainee programs, skilled visa expansions, etc., but from a macro perspective the inflow remains very limited. The literature consistently indicates that while immigration helps on the margins by easing labor shortages in specific sectors and slightly improving the dependency ratio and fiscal imbalances, it cannot fully offset the headwinds of declining fertility and increasing longevity. Japan would need an unrealistically massive migrant inflow to stabilize its workforce size, which may bring economic, social, and political constraints. The studies suggest Japan should view increased immigration as one complementary tool among many, rather than a panacea for ongoing demographic aging.

4.4 Fertility and family formation

At the root of Japan's fiscal sustainability and demographic issues lies persistently low fertility, together with a falling marriage rate. This is a common phenomena across many countries and has motivated a growing macroeconomic literature that treats

marriage, fertility, and household members' time allocation as endogenous choices shaped by economic incentives, technology, and policies surrounding families. For comprehensive reviews of data and workhorse models of family and macroeconomics, see Doepke and Tertilt (2016), Doepke et al. (2023), and Greenwood et al. (2023).

More broadly, a large macroeconomic literature has emphasized how economic development, rising returns to human capital, and gender-specific labor market incentives jointly shape fertility and marriage decisions. Unified frameworks linking fertility, education, and growth highlight how rising wages and stronger incentives for human capital investment generate a quantity–quality trade-off, representing the trade-off between the number of children and the resources devoted to each child, that contributes to declining fertility as economies develop. Incorporating household decision-making and gendered labor supply responses, quantitative models show that taxes, work incentives, and time allocation within families play a central role in shaping marriage and fertility outcomes. For some countries including Japan and Korea, empirical and structural studies emphasize that long working hours, limited flexibility, and institutional features of the labor market interact with household decisions to raise the opportunity cost of marriage and childbearing for women, reinforcing persistent gender specialization and low fertility.

Structural models of family formation, ranging from dynastic fertility frameworks to marriage-market and OLG models, aim to explain incentives for men and women to marry and give birth to children in a changing environment, and to ultimately understand why fertility remains low despite various policy interventions and quantify the long-run macroeconomic and welfare effects of family policies such as child benefits and childcare support.

For Japan, these models emphasize the interaction between women's labor market opportunities, the high cost of child-rearing, both in terms of time and financial costs, and persistent gender asymmetries in household responsibilities. They highlight why pro-natal policies tend to have modest short-run effects and why demographic recovery, even if achievable, may unfold only very gradually.

Extending the work by Greenwood et al. (2023) by incorporating gender differences, Kitao and Nakakuni (2025) develops a quantitative general equilibrium model to explain long-run changes in fertility, marriage, educational attainment, and time use within families in Japan over the past five decades. The authors endogenize family formation, education investment, and women's time allocation decisions, along with multiple forms of technological change: neutral, skill-biased, and gender-biased, as well as evolving childcare and home production costs. Calibrated to Japanese historical data, the model shows that technological advances favoring female labor supply, together with rising financial and time costs of childcare, have been one of the key drivers of the declines in fertility and marriage rates; neutral productivity growth increased leisure and reduced work hours; skill-biased technological change raised educational attainment; and improvements in home production technology reduced housework time for married women. Yanagimoto (2024) introduces leisure technology growth as a key driver behind the structural change in Japan's household behavior, including a decline in marriage and fertility rates. The model incorporates intra-household bargaining as well as a shift in leisure technologies, which increases

the value of single life relative to marriage and parenthood, partly accounting for the decline in marriage and fertility during the past few decades.[29]

Not only in Japan, but also neighboring economies including Korea, China, and other Asian countries face severe demographic challenges driven by declining fertility rates. While institutional settings and macroeconomic conditions differ, these economies share common forces: growth in education levels, especially that of women, and their labor market opportunities, rising child-rearing and education costs, intensive parenting norms, and labor market practices that make it difficult to reconcile career advancement with family life. As in Japan, these factors may interact to depress marriage and fertility, raising concerns about long-run growth of the labor force and fiscal sustainability.

Focusing on Korea, Kim et al. (2024) provides a novel explanation for Korea's low fertility by linking it to "education fever" through a status externality in parental education investment. It documents causal spillovers in private education spending using regional variation in hagwon curfews, showing that reductions in education spending by high-income families lower spending among poorer families. Using a quantitative model, they show that the status externality substantially depresses fertility and disproportionately increases childlessness among low-income households. The model is used to evaluate pro-natal transfers and education taxes, showing that both can raise fertility but at the cost of lower education investment and long-run human capital. The finding is consistent with that of Kitao and Nakakuni (2025), who argue that a lower cost of education can shift the quantity-quality trade-off toward higher educational investment per child, unintentionally leading to lower fertility.

A related and more general mechanism is emphasized by Ramey and Ramey (2010), who document a long-run shift toward increasingly time-intensive child-rearing in advanced economies. Using U.S. data, they show that parents, especially highly educated mothers, have substantially increased the amount of time devoted to childcare, despite rising wages and improved household technologies. Their findings offer an insight behind the experience of East Asian countries including Japan and Korea in that when combined with strong educational competition and gendered time constraints, rising childcare intensity can further depress fertility and limit the effectiveness of conventional family policies.

Complementing these empirical and structural approaches, Kang (2024) estimates a dynamic tournament model of college admissions that jointly incorporates parental monetary investment on private tutoring and children's own study effort, two margins that are typically studied in isolation. Using rich Korean longitudinal data that track tutoring expenditures, study time, and test scores over adolescence, the paper quantifies how competition for scarce seats at prestigious colleges translates parental income into children's lifetime earnings, showing the strong connection between parental investment and intergenerational persistence, while children's self-study acts as a mitigating force. The author also shows that shrinking cohort size can increase tutoring by low-income households and that banning private tutoring raises mobility at the cost of higher inequality.

[29] For more studies about childcare benefits using structural models, see, for example, Nakakuni (2024) and Hagiwara (2025).

A recent paper by Nakakuni (2025) focuses on how fertility choices affect insurance against income risk, in a general-equilibrium model that incorporates fertility decisions, college enrollment, and intergenerational transfers in incomplete markets. Building a model calibrated to the Japanese data, the paper shows that means-tested college subsidies increase fertility even absent a reduction in the expected monetary cost of children, because fertility choices are irreversible, and income uncertainty raises the expected marginal utility cost of having an additional child. Income-tested subsidies partially insure parents against the risk of being unable to finance children's education after adverse income shocks.[30]

The literature shows that persistently low fertility and declining marriage rates arise from the interaction of economic development, technological change, and institutional constraints rather than from the absence of desirable family policies alone. Rising returns to human capital, expanding female labor market opportunities, and increasingly intensive investments in children reshape the quantity–quality tradeoff, while long working hours and gendered practices both in the market and at home raise the opportunity cost of family formation. Structural models for Japan and neighboring Asian economies highlight that these forces generate gradual and persistent demographic decline, limiting the short-run effectiveness of pro-natal interventions. Recent work further emphasizes education competition, status externalities, and income risk as potential amplifying mechanisms, underscoring the need for policy packages that jointly address various issues surrounding families, including the labor market institutions, and education systems.

5 Concluding remarks and future research

Japan's economy faces multiple structural challenges. As discussed throughout this survey, Japan's accumulated public debt is exceptionally large by OECD standards and continues to increase. If this trajectory persists, concerns regarding debt sustainability are likely to intensify. To date, however, low sovereign yields (low interest rate of JGBs), supported by the Bank of Japan's accommodative monetary policy and abundant domestic savings, have helped maintain market confidence.

Since around 2024, the macroeconomic environment surrounding Japan has begun to change. The economy has shown clearer signs of exiting its prolonged deflationary phase, accompanied by rising inflation and nominal interest rates. It remains to be explored to what extent the increase in inflation and interest rate in Japan reflects current and expected future fiscal imbalances due to demographic aging and to what extent it reflects trade and other external factors. The termination of the zero interest rate policy and large-scale quantitative easing, along with the reemergence of positive long-term government bond yields, suggests a return to an environment in which interest rates once again play an active role. These developments introduce new perspectives on the sustainability of Japan's long-accumulated public debt. In particular, the interaction among inflation, rising policy rates, and government bond yields

[30] For other papers examining the relationship between fertility and labor market risk, see, for example, Cubeddu and Ríos-Rull (2003) and Güner et al. (2024), in the context of the U.S. and Spanish economies, respectively.

remains underexplored in the academic literature and constitutes an important avenue for future research.[31]

Moreover, while much of the existing literature evaluates future fiscal burdens in terms of consumption tax equivalents, there is no consensus regarding the optimal distribution of these burdens. Reassessing the design of the social security system—taking into account intergenerational equity and its interaction with economic growth—remains a central challenge..

Finally, as discussed in Sect. 4, closer attention must be paid to the interaction between labor market policies, household behavior, and macroeconomic outcomes. Japan's declining fertility rate has accelerated since the COVID-19 pandemic, with birth numbers falling faster than official projections. Although various policy measures have been implemented, their effectiveness remains limited. Further research is needed to assess how policies aimed at addressing demographic decline interact with fiscal sustainability and macroeconomic performance. In this context, the potential roles of increased female and elderly labor force participation, as well as labor substitution through technological progress such as AI—particularly in labor-intensive sectors like social security and care services—deserve careful examination.

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[31] See, for example, papers by Hu et al. (2023), Angeletos et al. (2024), Braun and Ikeda (2025a, 2025b) that use a life-cycle framework to analyze the interaction of the fiscal and monetary policy, which jointly determine the price level and the trajectory of real value of government debt.

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