Universal Insurance with In-Kind Transfers: The Welfare Effects of Long-Term Care Insurance in Japan *

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Abstract

This study quantifies the welfare effects of the public long-term care insurance (LTCI) system in Japan, focusing on the role of a universal insurance system with in-kind benefits, in a rich overlapping generations model with two-sided altruism. The welfare effects of LTCI reform depend on caregiver labor productivity and the generosity of the means-tested welfare program. When caregiver productivity is low, the universal LTCI with cash benefits can improve welfare to a greater degree than a system with in-kind benefits, despite the positive impact of the in-kind policy on caregiver labor supply. Cash benefits can maintain positive welfare effects while reducing government spending on LTCI. Eliminating universal LTCI shifts the burden of care to families and increases reliance on the welfare program, partially offsetting reductions in government expenditures.

Keywords: Social security, Long-term care, Long-term care insurance, Overlapping generations model, Fiscal sustainability, Japan.
JEL Classification: D15, E21, I10, I13, J14

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1 Introduction

With increasing life expectancy, aging populations have become a global challenge. This high life expectancy is a result of advances in medical technology, higher income and education levels, and good access to healthcare systems (OECD 2017). However, cognitive and physical decline is unavoidable, and not everyone remains healthy.[1] In Japan, which is at the forefront of this demographic shift, almost 20% of individuals aged 65 years and over, and about 60% of those aged 85 years and above, face difficulties with activities of daily living (ADL) or instrumental activities of daily living (IADL).[2]

How should the government deal with the rapid increase in long-term care (LTC) demand? As the proportion of older adults in the later stage of life keeps rising, the Japanese government expects significant increases in both the burden on families and LTC-related government spending. When older adults become disabled and require care, they and their families face substantial burdens from both family caregiving and care expenditures. There are the following care options: informal care (IC) provided by family members, formal home care (FHC) provided at home, and nursing home care (NHC).[3,4] In other words, they face a trade-off between substantial expenditures on formal care (FC) services and the loss of labor opportunities due to family caregiving. To tackle these issues, the government introduced a public long-term care insurance (LTCI) system. However, in an economy with an aging population and declining fertility rates, caregiving resources are limited. With increasing longevity, social security spending accounts for almost 22% of GDP, and LTCI spending has also increased significantly, accounting for about 9% of social security expenditure in 2019. As a result of the declining working-age population, the number of caregivers for IC or FC services decreases. This study analyzes the policies that should be implemented to address LTC risks. This study also analyzes how LTC risks affect the life-cycle behavior of individuals and families, quantifies the welfare effects, and evaluates the roles of care policies.

The demand for LTC services is highly persistent and almost irreversible. The risk of disability increases rapidly with age, particularly after the mid-70s. Once older adults

[1] See, for example, Christensen et al. (2009) and Chatterji et al. (2015).

[2] These percentages represent individuals officially certified as needing long-term care or support by the public LTCI system, according to the 2020 Status Report on Long-term Care Insurance by the Ministry of Health, Labour and Welfare (MHLW).

[3] As documented in Fu et al. (2017), FHC services include housekeeping, bathing, visiting nurses, rehabilitation, day services, short-stay services, medical care management counseling, welfare device leasing/purchasing, and home renovation. In contrast, NHC services, as well as chronic care hospitals, are included in institutional services.

[4] This study does not consider private NHC services because public NHC account for most of the total institutional capacity and information on private institutions is not available in sufficient detail. Website: https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000171814.pdf (in Japanese) (Accessed January 23, 2025).

require care, they rely on LTC services until the end of life. The eligibility rate for LTCI is generally higher among females than males, while mortality risk is consistently higher for males across all ages and disability statuses. We incorporate these distinct trajectory patterns of LTC risks into a structural model, using transition probabilities estimated by Mikoshiba et al. (2024) from nationwide administrative LTCI claims data. Given that Japan's LTCI system objectively and scientifically measures the degree of care needs, this study captures the heterogeneity in LTC risks.

Even after introducing in-kind LTCI, IC by family members—particularly working-age adult children—is the most common source of care for older parents. Around 80% of LTCI recipients use at-home care services, while the remaining 20% rely on NHC services. Among those receiving at-home care, almost 70% use a combination of IC and FHC services. However, caregiving is highly dependent on family members. With increasing disability severity, care hours double and the substitutability between IC and FHC weakens. Moreover, regardless of wealth, more than 80% of widowed parents rely on their adult children as primary caregivers, with wealthier parents being more likely to do so.

We develop a rich structural overlapping generations model populated by heterogeneous agents with two-sided altruism. Families consisting of older parent and adult child households jointly make decisions to maximize the same objective function, choosing the life-cycle allocation of consumption for each generation, family savings, the labor supply of female adult children, and care arrangements. Families differ in age, education of each generation, health status and previous care arrangements of the female older parent generation, and idiosyncratic wage shocks in the female adult child generation. This study focuses on care arrangements between widowed females and their working-age female adult children. Families choose among three types of care services—IC provided by female adult children at home, FHC at home, and public NHC—through a two-stage decision-making process. Understanding how LTC risks and LTCI system affect the labor supply of working-age children is crucial, particularly considering population aging, shrinking tax revenues due to the rapid decline in the labor force, and rising fiscal burdens.

Our model considers determining care arrangements for families, which depends on the opportunity cost of caregivers and family's savings. The opportunity cost for caregivers is high, as providing IC severely impacts their participation in the labor market. Furthermore, savings provide a crucial source of insurance against LTC risks in old age. When older adults face disability shocks, their families use their savings to cover significant expenditures on FC services. Families with sufficient savings have to choose between reducing the current labor income of working-age adult children due to providing IC and having smaller bequests resulting from using savings to purchase FC services. Conversely, families without sufficient savings rely on IC services or means-tested welfare programs to meet their care demands.

We calibrate our structural model to the Japanese economy in 2015. Our model replicates the overall patterns of care arrangements. We evaluate the universal LTCI system with in-kind benefits by quantifying its welfare effects as compared to alternative LTC policies.

When evaluating the ideal form of benefits under universal LTCI, we find that a cash benefit system is more efficient in improving welfare. Due to the higher cost of purchasing FC services, a cash benefit system encourages families to increase their use of IC services and reduce their labor force participation. Cash benefits compensate for the reduction in caregivers' labor income, resulting in decreased average savings. Although cash benefits negatively affect the labor supply of caregivers, the welfare effects depend on their labor productivity. Because caregivers have lower labor productivity, the decline in labor income tax revenue is modest and the tax adjustment effects are limited, resulting in positive welfare effects. This limited impact suggests that positive welfare effects can be maintained even if government expenditures on LTCI are reduced. This study shows positive welfare effects from a 5% reduction in LTCI spending.

Furthermore, to assess whether the scope of LTCI should be restricted, we consider an extreme scenario: LTCI is eliminated, and means-tested welfare programs become the only LTC policy. This study finds that universal LTCI well protects families against LTC risks when the welfare programs are generous. Eliminating universal LTCI shifts the caregiving burden to families and increases reliance on IC and means-tested welfare programs. While higher LTC risks can induce precautionary savings on average, the substantial burden would deplete the savings of poorer families. When the generosity decreases, the welfare loss caused by LTC risks outweighs the welfare gains from sufficient compensation through tax adjustments by reducing LTCI expenditures.

This study builds on multiple lines of literature. First, this study is directly related to the macroeconomic literature on the impacts of health risks and social security policies for older adults. While many studies have analyzed the economic and welfare effects of health and medical expenditure risks,[5] this study contributes to the growing literature on disability risks. Kopecky and Koreshkova (2014) analyze precautionary savings and show that NHC expenditures constitute a significant portion of aggregate wealth. İmrohoroğlu and Zhao (2018) emphasize the role of family caregiving, and Bueren (2023) focuses on the role of concurrent cognitive and physical limitations. Lockwood (2018) shows that LTC-related savings lead to substantial bequests. Ameriks et al. (2020) examine the relative importance of LTC-related and bequest motives. Davidoff (2010) and Barczyk

[5]As economic effects, Palumbo (1999) and De Nardi et al. (2010) show that large out-of-pocket spending on healthcare in later years of life is important in explaining why wealthy older adults dissave slowly during retirement. See also, Capatina (2015) and De Nardi et al. (2024) on lifetime economic inequality, Hosseini et al. (2024) on employment and earnings, and De Nardi et al. (2023) on saving behaviors by marital status. Regarding insurance policies, see Attanasio et al. (2010), Conesa et al. (2018), De Nardi et al. (2010), Braun et al. (2017), and Fukai et al. (2021).

et al. (2023) examine the role of housing.

Recent studies examine the effects of insurance policies, particularly means-tested care programs (i.e., Medicaid). Barczyk and Kredler (2018) and Bueren (2023) argue that IC should be considered. Without IC, welfare effects may be overestimated. Barczyk and Kredler (2018) show that non-means-tested IC and NHC subsidies improve welfare, even when the generosity of means-tested programs is reduced. Lieber and Lockwood (2019) analyze in-kind transfers to means-tested at-home care, accounting for moral hazard costs. Koreshkova and Lee (2024) examine the interaction with the NHC market. Other studies analyze how means-tested programs affect demand for private LTCI.[6]

Our study relates most to Barczyk and Kredler (2018). Both studies analyze the welfare effects of care policies and consider family caregiving. While Barczyk and Kredler (2018) focus on means-tested programs, our study contributes to the literature by evaluating a universal LTCI system. Our findings apply to the evaluation of universal LTCI systems in other countries. Barczyk and Kredler (2019) show that universal LTCI systems with in-kind and/or cash benefits have been introduced in many developed countries. Furthermore, our research extends Barczyk and Kredler (2018) by not only considering IC and NHC but also incorporating FHC as additional care options. Importantly, we consider the simultaneous availability of IC and FHC at home. This is because failing to consider the mixed use of FHC and IC may overestimate the welfare effects of in-kind benefit policies. To the best of our knowledge, this study is the first to incorporate nationwide administrative LTCI claims data into a rich structural overlapping generations model. Previous studies, including Barczyk and Kredler (2018), estimate LTC risks based on subjective assessments. However, self-reported statuses tend to overestimate current conditions (e.g., Hosseini et al. (2022)). This study accurately assesses LTC risks, as Japan's LTCI system objectively measures care demands.

Second, we incorporate elements from the microeconomics literature that examine the effects of family caregiving on individual decision-making. Previous studies have highlighted the negative effects on the labor supply of caregivers.[7] Lilly et al. (2010) show that caregivers have lower labor force participation. Van Houtven et al. (2013) and Skira (2015) show the importance of opportunity costs in caregiving decisions. These effects are consistently found in studies using Japanese data (e.g., Sugawara and Nakamura 2014).[8] Caregiving decisions are influenced by alternative care options, such as substitution effects with FHC (Bolin et al. 2008; Bonsang 2009; Balia and Brau 2014) and NHC (Van Houtven and Norton 2004; Charles and Sevak 2005; Mommaerts 2018). Bonsang (2009) shows that

[6]Earlier studies include Pauly (1990) and Brown and Finkelstein (2008). For recent quantitative analyses, see Braun et al. (2019), Ko (2022), and Mommaerts (2025).

[7]Furthermore, although not addressed in our model, Schmitz and Westphal (2017) show long-run wage penalties, and Coe and Van Houtven (2009) show deterioration in mental health. See Lilly et al. (2007) and Bauer and Sousa-Poza (2015) for a comprehensive survey.

[8]See also Hanaoka and Norton (2008), Yamada and Shimizutani (2015), and Oshio and Usui (2018).

substitution effects between IC and FHC weaken as disabilities become more severe.

Recent literature on microeconomics focuses on the impact of LTC-related policies on family caregiving. Fu et al. (2017) show that universal LTCI with in-kind transfers positively affect caregivers' labor force participation, whereas Geyer and Korfhage (2015) find that LTCI with cash transfers has negative impacts. Coe et al. (2023) show that private LTCI with in-kind transfers reduces perceived IC availability and would affect the future behavior of adult children. Anand et al. (2022) show that paid family leave positively impacts the labor supply of spouses.

Third, this study contributes to the literature on fiscal sustainability under massive population aging. Braun and Joines (2015) and Kitao (2015) examine various policy options to maintain fiscal sustainability and argue for the urgent need to reform tax and social security systems. According to İmrohoroğlu et al. (2016) and Kitao and Mikoshiba (2020), increasing female labor force participation significantly impacts fiscal sustainability. Kitao and Mikoshiba (2024) show that tax and social security provisions, such as the spousal deduction and exemptions from social security premium payments for low-income dependents, significantly affect female labor force participation and human capital accumulation. Our study analyzes the effects of LTCI on the female labor supply. Regarding rising age-related expenditures, Hsu and Yamada (2019), Fukai et al. (2021), and Hagiwara (2024) analyze the welfare effects of health insurance reform using health insurance claims data; however, they only introduce a deterministic process of LTC expenditures and do not consider family caregiving.

The remainder of this paper is organized as follows. Section 2 provides an overview of Japan's public LTCI system and documents stylized facts on LTC risks and care arrangements. In Section 3, we introduce our quantitative overlapping generations model. Section 4 explains model's parametrization. Section 5 presents the numerical results, and Section 6 presents concluding remarks.

2 Public Long-Term Care Insurance System in Japan

2.1 Institutional Settings

Japan introduced the public LTCI system in 2000, becoming one of the first countries with mandatory public insurance schemes for LTC.[9] For a detailed description, see Appendix A.

Eligibility The insured consist of individuals who are 65 years and over, and individuals aged 40 to 64 years who are covered by the health insurance system. The insured under the LTCI system do not necessarily coincide with the recipients. This study focuses on

[9]For details on Japan's LTCI system, see Campbell and Ikegami (2000) and Tamiya et al. (2011).

individuals aged 65 years and over, who represent about 98% of the total recipients (about 6.82 million).

The LTCI eligibility is determined solely based on the level of care demanded, regardless of socioeconomic attributes, such as family and economic status, without means tests. The LTCI system quantifies the level of care demanded by calculating the standard hours of total care demanded. Based on standard hours of care, each older adult is classified into one of the eight levels of care needs.

The eight levels of care demanded consist of ineligible or independent, support-required level (SL)1-2, and care-required level (CL)1-5. The older adults classified as ineligible or independent are not eligible for LTCI. SL1 is the mildest and CL5 is the severest level of care needs. SL refers to the recipients who live independently but need help with IADL. CL refers to the recipients who need more assistance with ADL and IADL. CL1-2 include those who might be able to live alone if provided partial assistance with basic activities. In contrast, CL3-5 are assigned to more severe older adults who are unable to live without full support for daily life. Once classified as eligible for LTCI, reassessments are conducted every year in principle.

Coverage and Benefits The insurance system covers LTC service expenditures, including at-home care and NHC services. The insurance focuses on providing care services, without cash transfers, for concerns that family caregivers would continue to be exploited if care allowances are given.

The insurance system provides generous benefits. The system sets the maximum amount of services that can be purchased as benefits for each level of care. Within the ceiling amount, the insurance covers 90% of expenditures and sets the copayment rate at 10%. The rate exceeding the ceiling benefits is extremely low; in 2015, it was 1.3% of all recipients.

Recipients can choose their services and providers from the LTC market. The insurance system is then designed to emphasize at-home care over NHC services, driven by the growing demand for care and substantial fiscal concerns. The primary public NHC services (i.e., welfare care facilities for the elderly, *tokubetsu-yogo-rojin-home*) are only available to older adults with CL3-5.[10] The insurance does not cover living expenses and meal costs in nursing homes.

2.2 Data

To gain insights into the disability and mortality risk profiles in old age, as well as the care arrangement patterns among older adults with disabilities, this study uses two primary

[10]There are exceptions in cases where the level of care improves after entering nursing homes, or in cases of severe family circumstances such as abuse.

data sources: the Statistics of Long-term Care Benefit Expenditures (SLBE) and the Comprehensive Survey of Living Conditions (CSLC), both conducted by the MHLW.[11]

The SLBE Data The SLBE is a nationwide LTCI claims data that covers all residents in Japan as long as they are eligible for the LTCI.[12] This study uses one-year transition probabilities for disability and mortality risks, by age, sex, and the current level of care demanded, among individuals aged 65-94 years, estimated in Mikoshiba et al. (2024) using the 2006-2018 SLBE. Mikoshiba et al. (2024) constructed a one-year interval panel dataset (30,347,066 records) for a cohort from 1912 to 1951 (7,221,142 unique individuals), and subsequently calculated the average transition probabilities for each age, sex, and current level of care demanded from 2007 to 2018.

The CSLC Data The CSLC is a nationally representative repeated cross-sectional micro survey of the non-institutionalized population. The CSLC is established to provide comprehensive information on living status.

Since the SLBE does not contain sociodemographic and socioeconomic information, this study uses the CSLC to capture patterns of care arrangement among older adults with disabilities at home. This study uses the large-scale survey conducted in 2016. More details about the CSLC data are provided in Appendix B.

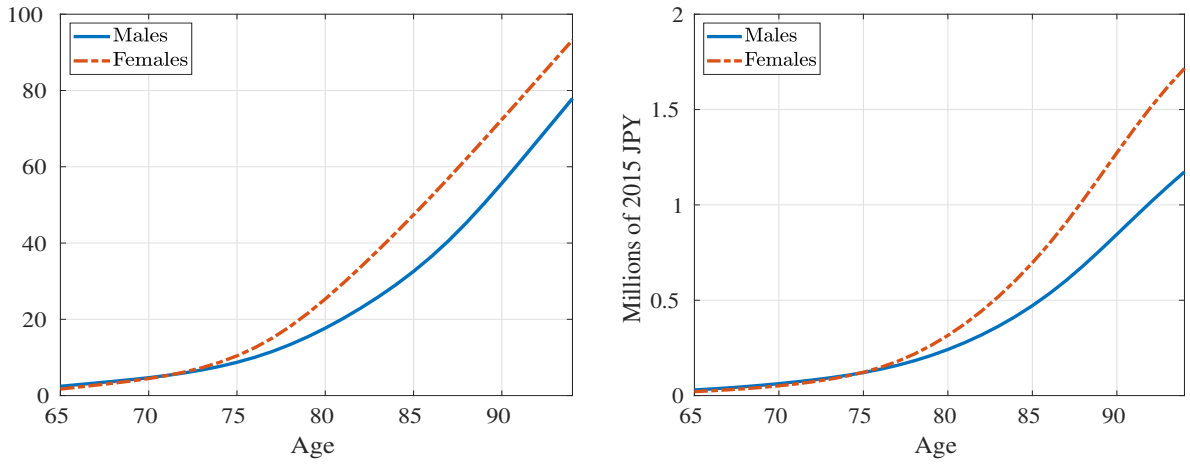
2.3 Long-Term Care Risks in Old Age

Average Disability Risks Figure 1 shows the average rate of older adults eligible for LTCI services and average annual gross LTC expenditures per capita by age and sex in 2015. As shown in Figure 1a, the average rate of eligible LTCI recipients increases nearly monotonically with age. The eligibility rate is relatively low and remains less than 10% until the mid-70s for both males and females. However, the rate grows sharply from their mid-70s and reaches 77.89% and 93.22% at 94 years old for males and females, respectively. Until the mid-70s, the rate is slightly higher for males than females but subsequently reverses after the mid-70s, with the rate for females greatly exceeding that for males.

From Figure 1b, it is apparent that average annual gross LTC expenditures per capita increase with the average eligibility rate, particularly after the mid-70s.

[11] Further detailed information can be found at: https://www.mhlw.go.jp/english/database/db-hss/soltcbe.html (for the SLBE) (Accessed September 13, 2024). https://www.mhlw.go.jp/english/database/db-hss/cslc-index.html (for the CSLC) (Accessed September 13, 2024).

[12] The SLBE includes recipients of the welfare transfer program who are eligible for free long-term care assistance. According to the National Survey on Public Assistance Recipients by the MHLW in 2020, of the LTCI recipients in 2020 (about 5.67 million), the recipients of the welfare transfer program were approximately 6.3% (about 0.32 million).



(a) Eligibility Rates for LTCI (%)

(b) Annual Expenditures on LTCI per capita

Figure 1: Eligibility Rates and Annual Gross Expenditures for LTCI per capita

Note: The data in Figure 1a are from the Report Survey on Situation of Long-term Care Insurance Service by the MHLW in 2015 and the Population Statistics of Japan by the National Institute of Population and Social Security Research (NIPSSR) in 2017. The data in Figure 1b are obtained from the SLBE by the MHLW in 2015 and the Population Statistics of Japan by the NIPSSR in 2017.

Heterogeneity of Disability Risks Although these average profiles provide suitable information on the expected disability risks and costs in old age, they do not provide information on the heterogeneity of individual risks. Therefore, this study demonstrates transition probabilities by age, sex, and current level of care needs estimated by Mikoshiba et al. (2024). To visualize the risk dispersion in different levels of severity of care, they classified long-term care status (LTC-status) into four categories based on the eight levels of care needs: no-disability if independent or ineligible for LTCI; light if the levels range from SL1 to CL2; heavy if the levels range from CL3 to CL5; and death if deceased. These estimated transition probabilities show significant heterogeneity in the risks of disability and mortality across different ages, sexes, and LTC-statuses. However, there are also distinct trajectory patterns in the transitions.

First, the disability risks are highly persistent and almost irreversible regardless of age or sex. Individuals of any current LTC-status most likely remain in the same status in the next year for all ages and sexes. For example, at age 80, the probability of remaining in the same LTC-status in the next year is approximately 70-90% and 80-95% for males and females, respectively. Additionally, once individuals become disabled and eligible for LTCI, they require continuous care until death. The probability of transitioning to no-disability status is nearly zero for all ages and sexes.

Second, disability and mortality risks differ for males and females. For all ages, females are more likely to remain in the same LTC-status in the next year than males. However, males have higher mortality rates than females for all ages and LTC-statuses. For example,

at age 80, males are about twice as likely as females to transition from any LTC-status to death status. As shown in Figure 1a, the eligibility rate is higher for females than males. Since mortality risks tend to be higher for those eligible for LTCI, the higher eligibility rate for females may seem contradictory to their higher survival probability for females. This can be explained by the fact that mortality rates are higher for males than for females across different ages and LTC-statuses.

2.4 Care Arrangements

The Breakdown of Care Arrangements Table 1 provides a detailed breakdown of residential arrangements by calculating the ratio of recipients at home and in nursing homes to the total number of recipients using the SLBE.[13] As shown in Table 1, the majority of recipients (about 81.82%) receive care services at home. Although only about 18.18% of recipients use nursing homes, the ratio rises from 4.91% for those with light LTC-status to 38.97% for those with heavy LTC-status. This increase can be attributed to Japan's LTCI system, in which older adults with light LTC-status are not eligible for primary public NHC services.

Table 1: Care Arrangements of Older Adults with Disabilities

	At-home care				Public nursing homes
		Care arrangements at home (% at home)			
	All	Only IC	Mix IC-FHC	Only FHC	All
Those eligible for LTCI	81.82%	16.72%	56.22%	8.88%	18.18%
		(20.44%)	(68.71%)	(10.85%)	
By LTC-status					
Light (SL1-CL2)	95.09%	21.60%	63.26%	10.23%	4.91%
		(22.72%)	(66.53%)	(10.75%)	
Heavy (CL3-CL5)	61.03%	8.84%	45.41%	6.78%	38.97%
		(14.48%)	(74.41%)	(11.11%)	

Note: The numbers in the table represent % of all cases. The data are from the SLBE and CSLC by the MHLW in 2016. The CSLC sample is constructed by matching household questionnaires with long-term care questionnaires, including those eligible for LTCI (65-94 years old), with information on the care level, caregivers, and the use of FHC services (5,145 observations). We classify care arrangements based on information on caregivers and the use of FHC services: receiving IC services if receiving care from their own child, child-in-law, spouse, and others; and receiving FHC services if using FHC services. The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

[13]For calculation, this study uses the SLBE, which offers data on the number of recipients at home and in nursing homes because the CSLC does not include information on the institutionalized population. The recipients in nursing homes consist of those in welfare care facilities for the elderly (*tokubetsu-yogo-rojin-home*), healthcare facilities for the elderly (*rojin-hoken-shisetsu*), and nursing care medical facilities (*kaigo-ryoyogata-shisetsu*).

Table 1 also shows the breakdown of at-home care,[14] according to three types of care provision—only IC, the mixed use of IC and FHC, and only FHC. We classify at-home care arrangements based on information on relationships with caregivers and the use of FHC services. Looking at Table 1, it is apparent that a substantial number of older adults use both IC and FHC at home, accounting for 56.22% of care arrangements (68.71% of at-home care arrangements). Compared to the U.S. and European countries, the mixed use of IC and FHC services in Japan is considerably higher: Barczyk and Kredler (2019) show that in U.S. and European countries, around 20% of individuals receive both IC and FHC services at home. This may be explained by Japan's insurance system, which provides a benefit-in-kind policy that emphasizes at-home care rather than NHC services.

The Burden of Caregiving at Home As shown in Table 1, there are a considerable number of older adults who use both IC and FHC at home. This appears to contradict the substitution effects between IC and FHC services. To examine whether the mixed use of IC and FHC is attractive or whether families rely heavily on one type of care, Table 2 shows the burden of caregiving at home.

Table 2: The Burden on Caregiving at Home

	Distr. of primary caregivers (% of all cases)			The intensity of care by primary caregivers (out of all care hours)	Care hours (annual hours)
	IC (child)	IC (spouse)	FHC		
Those eligible for LTCI	50.68%	30.96%	14.29%	68.59%	1904.00
By LTC-status					
Light (SL1-CL2)	52.49%	29.24%	14.00%	70.00%	1424.83
Heavy (CL3-CL5)	45.94%	35.44%	15.07%	65.15%	3094.82

Note: The data are from the CSLC by the MHLW in 2016. The CSLC sample is constructed by matching household questionnaires with long-term care questionnaires, including those eligible for LTCI (65-94 years old). **Care hours**: We limit the sample of the first-third column to observations with information on the time of the IC and FHC services and monthly expenditures of the FHC services (4,343 observations). Annual total care hours are the sum of annual IC and FHC hours, computing the average annual FHC hours by the total expenditures and the average cost of FHC per hour. **Distr. of primary caregivers**: The sample is limited to observations with information on the level of care, primary caregivers, other caregivers, and the use of FHC services (5,145 observations). The primary caregivers at home are classified into four groups: children if they receive IC from their own child or child-in-law; spouses if receive IC from their spouse; others if receive IC from other family members or others; and FHC if receive FHC. **Hours by primary caregivers**: We limit the sample for the fourth column to observations with positive annual total care hours (4,262 observations). The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

Since the breakdown of at-home care in Table 1 only shows the combination of care use, it is useful to gain an understanding of who is providing care and how much care

[14]To document care arrangements at home, this study uses the CSLC by constructing a sample ("care sample"). This sample includes individuals eligible for LTCI services, aged between 65 and 94 years, and with information on the care level and caregivers. See Appendix B for more details.

is being provided. The first-forth columns then show who primary caregivers are, and the intensity of care provided by primary caregivers. When looking at the distribution of primary caregivers, children, and spouses account for about 81.64% of primary caregivers. The fourth column shows that primary caregivers provide approximately 68.59% of total care hours. Considering that primary caregivers are family caregivers, this indicates that caregiving burdens are concentrated on informal caregivers. Moreover, as the severity of disability rises, older adults receiving both IC and FHC within at-home care increase, and the intensity of primary caregivers decreases. This suggests that substitution effects between IC and FHC disappear as the level of disability rises, as shown in Bonsang (2009).

This decreasing trend in substitution effects would reflect longer hours of care. The last column of Table 2 shows the average annual care hours provided to older adults with disabilities. The average care hours in heavy LTC-status are about twice as high as those observed in cases of light LTC-status. Individuals with light LTC-status receive an average of around 3.90 hours of daily care, whereas individuals with heavy LTC-status receive about 8.48 hours of care per day. It then becomes difficult to leave all at-home care to formal home caregivers in the market.

Care Arrangements at Home by Family Structure As shown above, IC is the most preferred care option. However, its availability heavily depends on family structure. To be more precise, it relies on the presence of individuals who can provide IC. For instance, for childless older adults, child-provided IC is not an available option. Even if older adults have at least one child, they cannot receive IC if their children live far away.

This study then examines the presence of spouses and children among the care sample of the CSLC.[15] Regarding marital status, approximately 95% of the sample is comprised of widowed (51%) and married individuals (45%). Regarding children, around 91% of the sample has at least one child, and approximately 87% of them have at least one child residing together or in the same municipality.

Furthermore, to describe at-home care arrangements by family structure, this study narrows down the care sample to those who are widowed or married, with at least one child living together or in the same municipality (the "family sample"). The family sample accounts for 71.26% of the care sample. More than half of the family sample consists of widowed females, making up about 50.76%. Married males, married females, and widowed males constitute 24.86%, 16.74%, and 7.91%, respectively.

Table 3 presents at-home care arrangements by family structure. The first-third rows show that about 90% of widowed females have their children as primary caregivers. These primary caregivers are predominantly female (67.63%) and of working-age (average age 58.67 years). In contrast, the fourth-sixth rows show that almost 70% of primary caregivers for married males are their wives. These wives have already retired from the labor

[15] More details about the care sample and family sample are provided in Appendix B.

market: their average age is 76.67 years and they have lower labor force participation rates (11.86% versus 17.46% among all in their 70s). Moreover, regardless of family structure and LTC-status, primary caregivers provide high care intensity to recipients, while about 70% of recipients use IC and FHC services at home. These trends for widowed females and married males are also observed for widowed males and married females, respectively.[16]

Table 3: The Burden on Caregiving at Home by Family Structure

	Distr. of primary caregivers (% of all cases)			The care intensity by primary caregivers (out of all care hours)	Care arrangements (% of all cases)		
	IC (child)	IC (spouse)	FHC		Only IC	Mix IC-FHC	Only FHC
Widowed Females							
Those eligible for LTCI	88.40%	0.00%	9.71%	65.11%	18.06%	75.42%	6.52%
By LTC-status							
Light (SL1-CL2)	90.21%	0.00%	7.60%	65.83%	20.87%	74.49%	4.64%
Heavy (CL3-CL5)	83.30%	0.00%	15.70%	63.27%	10.10%	78.05%	11.85%
Married Males							
Those eligible for LTCI	26.14%	68.09%	5.05%	66.19%	26.25%	71.30%	2.45%
By LTC-status							
Light (SL1-CL2)	27.34%	67.81%	4.07%	68.12%	28.84%	68.50%	2.65%
Heavy (CL3-CL5)	23.97%	68.58%	6.81%	62.55%	21.57%	76.35%	2.08%
Married Females							
Those eligible for LTCI	39.94%	52.70%	6.90%	68.28%	25.45%	70.44%	4.11%
By LTC-status							
Light (SL1-CL2)	38.07%	53.83%	7.44%	70.88%	29.26%	66.28%	4.46%
Heavy (CL3-CL5)	44.12%	50.18%	5.70%	62.66%	16.89%	79.77%	3.33%
Widowed Males							
Those eligible for LTCI	81.39%	0.00%	16.53%	68.92%	17.27%	68.46%	14.27%
By LTC-status							
Light (SL1-CL2)	85.89%	0.00%	14.11%	69.29%	18.47%	69.02%	12.50%
Heavy (CL3-CL5)	68.45%	0.00%	23.48%	67.79%	13.79%	66.85%	19.36%

Note: The data are from the CSLC by MHLW in 2016. The CSLC sample is constructed by matching household questionnaires with long-term care questionnaires, including those who are eligible for LTCI (65-94 years old) and those who are widowed or married with at least one child living together or in the same city. **Distr. of primary caregivers**: The sample is limited to observations with information on the level of care, primary caregivers, other caregivers, and the use of FHC services (1,865, 915, 606, and 292 observations for widowed females (WF), married males (MM), married females (MF), and widowed males (WM), respectively). **Hours by primary caregivers**: We limit the sample of the first-third column to observations with information on the time of the IC and FHC services and monthly expenditures of the FHC services (1,552, 783, 511, and 253 observations for WF, MM, MF, and WM, respectively). **Care arrangements**: This study uses the sample of the first-third column. The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

From these stylized facts, our model considers widowed females and married males, who make up the majority (75.62%) of the family sample. In particular, this study explicitly models widowed females and their working-age female children because they are the most common family structure among the family sample. On the other hand,

[16]See more details on primary caregivers by family structure in the family sample in Appendix B.

this model implicitly incorporates the characteristics of married men whose caregivers are their wives who have already retired from the labor market.

Care Arrangements at Home by Family Wealth Several quantitative papers, such as Kopecky and Koreshkova (2014), have argued that savings provide a source of insurance against long-term care risks. When older parents face disability shocks, their families can use savings to cover the substantial costs of FC services. Figure 2 reports the primary caregiver rate by family wealth quintile, focusing on disabled widows who have at least one child in the same municipality. Regardless of their wealth, over 80% of families rely on their children as their primary caregivers. In fact, families with more wealth are more likely to have their children as their primary caregivers. This suggests that family wealth may be important in care arrangements.[17]

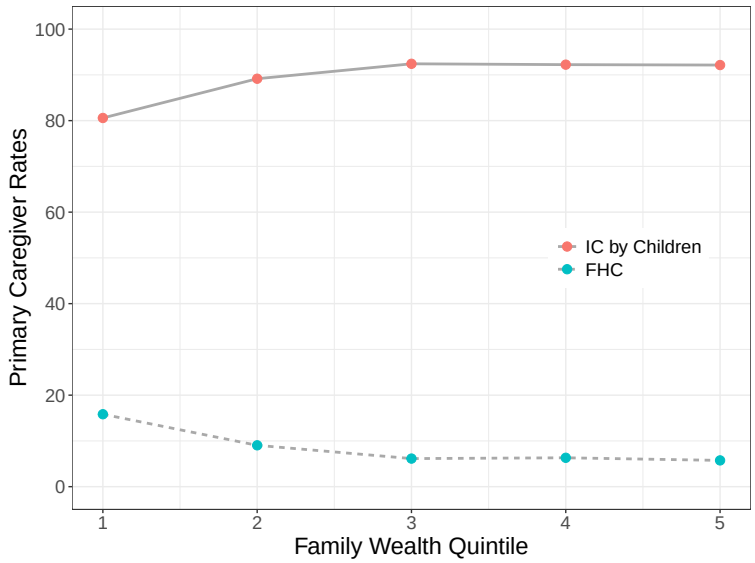


Figure 2: Primary Caregivers at Home by Family Wealth

Note: The data source is from the CSLC by the MHLW. The sample is contracted from large-scale surveys from 2016 to 2019 by matching household questionnaires with saving questionnaires, including those who are eligible for LTCI (65-94 years old) with information on primary caregivers and those who are widowed with at least one child living together or in the same city (1,119 observations). The level of wealth quintile is based on the 2014 values from Kitao and Yamada (2019), CPI adjusted to 2016 and 2019. The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

3 Model

In this section, we build a rich overlapping generations model with two-sided altruism. Families comprise two generations, each exhibiting altruism toward the other. There are uninsurable idiosyncratic risks and individuals face a no-borrowing constraint. The

[17]See Appendix C.2 for the motives of children caring for their parents.

sources of uncertainty in this model are disability and longevity risk in old age, permanent skill shocks, and wage shocks for working-age females. This is a partial equilibrium model, assuming that individuals take the paths of factor prices and various social security policies as given. The model time is discrete and the frequency is annual.

3.1 Demographics

The formalization of the family follows Fuster et al. (2007) and İmrohoroğlu and Zhao (2018), in the sense of two-sided altruism.[18] In this setting, living family members make a joint decision to maximize the same objective functions.

There is a dynastic framework with two stages: an adult child stage and an older parent stage. An individual lives as an adult child during the first J periods. At age $J+1$, they become an older parent in the next-generation household of the dynasty. At this time, they leave their labor force. From age $J+1$, they face disability and mortality risk in each period. The maximum possible age is $2J$.

A family is made up of two generations: an adult child generation (indexed by k) of age $j^k \in \{1, \ldots, J\}$ and an older parent generation (indexed by p) of age $j^p = j^k + J$. An individual's life overlaps with their older parent generation household during the first J periods and their adult child generation household in the last J periods. In each family, an older parent generation consists of one household, while an adult child generation consists of a household with measure $(1+\nu)$. The annual population growth rate is v_g and $\nu = (1+v_g)^J - 1$. In particular, a new generation in a family line is born only in every J period, while a new generation in the economy is born in every period.

During the initial period of each family ($j^k = 1$), each generation household consists of one married couple. Then, each family comprises four individuals from two generations. Each family member is denoted as $i \in \{kf, km, pf, pm\}$, representing a female adult child, a male adult child, a female older parent, and a male older parent.[19] While an adult child generation household has two members during J periods, an older parent generation household has $n^p \in [1, 2]$ members.[20] A detailed explanation of the household members in the older parent generation household is presented in Section 3.3. To simplify the model, this study assumes that each household member within the same generation

[18] Previous empirical facts on parental transfers and child-provided IC are consistent with dynastic motive (two-sided altruism). For example, Hamaaki et al. (2019) find that older parents give a larger share to individuals of the family line and/or those who provide care to their parents. We discuss the modeling choice of two-sided altruism in Appendix C.2.

[19] The average completed number of children per married couple was stable at around 2.2 from 1970 to the early 2000s and dropped to 1.94 in 2015, according to the Annual Population and Social Security Surveys (The National Fertility Survey) from the NIPSSR.

[20] This study does not consider the risk of longevity in middle adulthood because the mortality rates for those 35–65 years are quite low, at 0.26%, according to the Japanese Mortality Database of the NIPSSR (Downloaded on June 27, 2022).

household has the same age and skill.[21] This study does not model the marriage decision and abstracts from divorce and remarriage.

3.2 Skill

Individuals differ by skill $z = \{L, H\}$, classified as low- and high-skilled. We define individuals as high-skilled if they have a college degree or higher, and low-skilled otherwise.

At birth, each stochastically inherits a skill z from their parents. Individual's skill state z is fixed throughout the life-cycle and affects their age-specific deterministic labor productivity $\epsilon(j^k, z)$. An individual's permanent lifetime labor efficiency is deterministic within their lifetime, whereas their permanent labor productivity is stochastic between parents and children. z follows a first-order Markov chain of two states with transition probabilities $\Omega(z' \mid z)$.

Since household members within the same generation have the same skills, four family types can be derived with skill combinations of older parents and adult children. Families of the type in which both parents and children are high-skilled are denoted as HH. The remaining three types are denoted HL, LL, and LH, with the first letter denoting parental skills and the second denoting children's skills.

3.3 Long-Term Care and Mortality Risk

At the beginning of each period, individuals in the older parent generation face disability and mortality risks. In this study, disability and mortality risks are summarized in h, denoting each individual's LTC-status. This study classifies LTC-status h into four categories based on the eight levels of care needs: no-disability ($h = 1$) if independent or ineligible for LTCI; light ($h = 2$) if the levels range from SL1 to CL2; heavy ($h = 3$) if the levels range from CL3 to CL5; and death ($h = 4$) if deceased.

This model only considers the LTC-status of females in the older parent generation to focus primarily on care arrangements between widowed females and their working-age female adult children—the most common family structure and care arrangements for older adults with disabilities—while keeping the dimensions of the state space manageable.

Transition of Long-Term Care Status The LTC-status of the female older parents in the next periods h' depends on her current LTC-status h and age j^p. The LTC-status h follows a first-order Markov chain with transition probabilities $\Psi(h' \mid h, j^p)$ of being LTC-status h' from age j^p to $j^p + 1$. The death state is the absorbing state for all ages j^p, $\Psi(h' = 4 \mid h = 4, j^p) = 1$. For simplicity, this study assumes that once individuals

[21] The average age difference between couples from 1975 to 2015 is 2.4 years. The data come from the Vital Statistics conducted by the MHLW. Moreover, there is a high degree of sorting for married couples in Japan. For further details, see Fukuda et al. (2021), which use the 1980-2010 Census data.

become disabled and eligible for LTCI, the probability of transitioning to no-disability status is zero for all ages, following the result of Mikoshiba et al. (2024).

$$\Psi(h' = 1 \mid h = 2, j^p) = \Psi(h' = 1 \mid h = 3, j^p) = 0 \quad \text{for all} \quad j^p$$

We also assume that the types of care services do not affect the mortality risk, as shown in Applebaum et al. (1988).

Composition of Older Parent Generation This model also captures quantitatively important aspects of the risks of disability and mortality for males in the older parent generation by assuming that the LTC-status of females affects the composition of the older parent generation as in Barczyk and Kredler (2018). The older parent generation household has $n^p(j^p, h) \in [1, 2]$ members.

When female members in the older parent generation are independent or ineligible for LTCI ($h = 1$), this study assumes $n^p(j^p, h) \in [1, 2]$ members in the older parent generation, consisting of one female and a male member of measure $n^p(j^p, h) - 1 \in [0, 1]$. The measure of the males decreases deterministically with age j^p. This assumption comes from the empirical fact that males have higher mortality rates than females for all ages. In addition, this study assumes that males are at deterministic risks of disability when females are independent or ineligible for LTCI. Therefore, males receive IC from their wives and pay copayment for average expenditures $H_{pm}(j^p)$ to receive FHC services. This assumption reflects the empirical facts that males tend to need care first compared to females, and that their primary caregivers are their wives, who are already retired from the labor market.

When females need care ($h = 2$ or $h = 3$), this study assumes that males die and females become widowed. Then, the household of the older parent generation has only one female, $n^p(j^p, h) = 1$.

When death shocks hit the female older parents ($h = 4$), both the female and male members (if still alive) die. This assumption also comes from the empirical fact that males have higher mortality rates than females for all ages. The older parent generation household has no members, and the family consists of only one generation, that is, the adult child generation.

3.4 Care Arrangements

When females in the older parent generation are eligible for LTCI ($h = 2$ or $h = 3$), their families choose among three types of care options: IC from their female adult children, FHC, and public NHC (welfare care facilities for the elderly).[22] This study models care arrangements as two-stage decision-making.

[22]This study does not consider private nursing homes as care options. Private nursing homes include fee-based homes for the elderly, residences with health and welfare services for the elderly, and group

First Stage: At-home Care versus Public Nursing Homes In the first stage, families make residential arrangements between at-home and public NHC services. This family's choice is denoted by $\iota \in \{0, 1\}$, which can be either at-home care services ($\iota = 0$) or public NHC services ($\iota = 1$). If the families choose public NHC services, they face their preference ξ when entering the public nursing homes.

Older adults with light LTC-status ($h = 2$) are not eligible to use primary public NHC under Japan's LTCI system. The residential arrangement occurs only for older adults with heavy LTC-status ($h = 3$).

Second Stage: Care Arrangements at Home If families opt for at-home care services ($\iota = 0$) in the first stage, they must determine both the allocated time for IC ϕ and expenditures for FHC q to meet the minimum requirement of total care hours $\chi(h)$.

$$A\left(\theta(h)(q/p)^{\rho} + (1 - \theta(h))(T(\phi) \times 365)^{\rho}\right)^{\frac{1}{\rho}} \geq \chi(h) \tag{1}$$

where A denotes the return to care input hours, p is the price of FHC per hour,[23] $\chi(h)$ is the minimum requirement of total care hours depending on the level of care ($\chi(h = 2) \leq \chi(h = 3)$), and ρ and $\theta(h)$ represent substitutability between IC and FHC. This formalization captures the heterogeneity of the care burden and the substitutability between IC and FHC by the level of care, following the formulation of Daruich (2018) and Gao (2020). The time use of IC ϕ is a discrete choice, with the corresponding IC hours.

$$T(\phi) = \begin{cases} 8 \text{ hrs per day} & \text{if } \phi = 1 \\ 4 \text{ hrs per day} & \text{if } \phi = 1/2 \\ 1 \text{ hrs per day} & \text{if } \phi = 1/8 \\ 0 \text{ hrs per day} & \text{if } \phi = 0 \end{cases}$$

Moreover, female older parents with disabilities exhibit preferences for IC, ω. If they have a positive preference for IC, the more hours they use IC, the higher the utility they receive, as shown in Section 3.6. The demand for IC would exceed the demand for FHC services covered by LTCI if the preference for IC is relatively high. While the preference for public nursing homes ξ affects the choice between at-home care and public nursing homes, the preference of the female older parents for IC ω affects the choice between IC and FHC services.

homes. According to the MHLW, public nursing homes account for the majority in terms of capacity, with welfare care facilities for the elderly (*tokubetsu-yogo-rojin-home*) in particular accounting for the highest proportions, although the capacity of private nursing homes has been increasing. In addition, information available on the occupancy rates in private nursing homes is insufficient. Therefore, this study only focuses on public nursing homes.

[23] In Japan's LTCI system, the central government established the fees for each LTCI service and revised them every three years. For further details on the fee, see, for example, https://www.mhlw.go.jp/topics/kaigo/housyu/housyu.html (in Japanese) (Accessed September 13, 2024).

Second Stage: Care Arrangements in Public Nursing Homes Once families select public NHC services ($\iota = 1$) in the first stage, female older parents with disabilities spend the rest of their lives in public nursing homes. The families are also required to pay both the cost of care services $\bar{q}$ and the facility fee $\bar{c}$ until they die.

3.5 Endowments

Individuals in the adult child generation work in the labor market.

Female Adult Children Female adult children allocate their disposable time to labor supply, leisure, and IC hours if their female older parents need care. At the beginning of each period, female adult children face an idiosyncratic wage shock, $\mu(j)$. The earnings of female adult children are defined as follows.

$$y_{kf}(j,z) = \epsilon(j,z)\mu(j)\frac{1}{\overline{WH}_{kf}(j)}\left(\overline{DH}_{kf}(j) - \mathbb{1}_{h\in\{2,3\}}T(\phi) - l\right)$$

where $\epsilon(j,z)$ is deterministic age-specific efficiency, $\overline{WH}_{kf}(j)$ is the average working hour, $\overline{DH}_{kf}(j)$ is disposable time, and l is leisure. The idiosyncratic wage shock $\mu(j)$ follows the autoregressive AR(1) process.

$$\log(\mu(j)) = \Theta\log(\mu(j-1)) + \zeta(j),\ \zeta(j) \sim N(0,\sigma_\zeta^2)$$

where $\zeta(j)$ is normally distributed with a mean of zero and variance σ_ζ^2, and $\Theta < 1$ captures the persistence of the shock. This study discretizes this process into a three-state Markov chain using the method of Tauchen (1986). Let $\Lambda(\mu,\mu')$ be the transition matrix of the idiosyncratic wage shocks. It is also assumed that μ at birth is determined by random draw from initial distribution $\overline{\Lambda}(\mu)$.

Male Adult Children This study assumes that male adult children supply labor inelasticity because the average labor force participation of working-age males is high. For example, the labor force of 35–64-year-old married males is approximately 95.3%, according to the 2017 Employment Status Survey of the Ministry of Internal Affairs and Communications (MIC). The earnings of male adult children are denoted by y_{km}, which evolve deterministically throughout the life-cycle and depend on age and skill $y_{km}(j,z)$.

3.6 Preferences

The utility of the family is the sum of the adult child generation's utility u_k and the older parent generation's utility u_p in the sense of two-sided altruism.

Adult Child Generation An individual in the adult child generation derives utility from their generation's consumption c_k and leisure l_i for $i = \{kf,\ km\}$. The instantaneous utility of the adult child generation is given as follows.

$$u_k(c_k, l_{kf}) = \frac{(1+\nu)}{1-\sigma}\left(\left(\frac{c_k}{(1+\nu)\eta(2)}\right)^{1-\gamma}\bar{l}_{km}^{\gamma}\right)^{1-\sigma} + \frac{(1+\nu)}{1-\sigma}\left(\left(\frac{c_k}{(1+\nu)\eta(2)}\right)^{1-\gamma} l_{kf}^{\gamma}\right)^{1-\sigma}$$

where l_{kf} denotes the leisure of the female adult child, $\bar{l}_{km}$ represents the exogenous leisure time of the male adult child, and $\eta(n)$ is the equivalence scale that varies with the family size.

Older Parent Generation The utility of the older parent generation depends on their generation's consumption c_p and the time of use of IC ϕ (when the female older parent with disability selects at-home care).

$$\begin{aligned} u_p(c_p, \phi) \ &= \frac{n^p(j^p, h) - 1}{1-\sigma}\left(\left(\frac{c_p}{\eta(n^p(j^p, h))}\right)^{1-\gamma}\bar{l}_{pm}^{\gamma}\right)^{1-\sigma} \\ &+ \frac{1}{1-\sigma}\left(\left(\frac{c_p}{\eta(n^p(j^p, h))}\right)^{1-\gamma}\bar{l}_{pf}^{\gamma}\right)^{1-\sigma} + \mathbb{1}_{h\in\{2,3\}}\mathbb{1}_{\iota=0}(\omega\phi) \end{aligned}$$

where ω represents the preference parameter for IC. If $\omega > 0$, the female older parent prefers IC to FHC. Leisure l_i for $i = \{pf,\ pm\}$ is the exogenous time of the individual in the older parent generation.

3.7 Government

The government operates the following social insurance programs: LTCI, health insurance, pay-as-you-go public pension, and means-tested welfare transfer program.

Public Long-Term Care Insurance The government provides the mandatory public LTCI system based on the level of care demanded, regardless of socioeconomic attributes. All individuals 65 years and above receive care services covered by LTCI if they are certified as needing care or support. Out-of-pocket LTC expenditures paid by each recipient are denoted as H_i^{oop} for $i \in \{pf, pm\}$ and expressed as follows.

$$\begin{aligned} H_{pf}^{oop} &= \lambda^h q \\ H_{pm}^{oop} &= \lambda^h H_{pm} \end{aligned}$$

where λ^h is the copayment rate of the LTCI. The government covers the fraction $(1-\lambda^h)$ of gross LTC expenditures.

Public Health Insurance The government also offers a mandatory public health insurance program. This study assumes that medical expenditures are required when individuals are in the older parent generation.[24,25] The average annual gross medical expenditures are given exogenously, $M_i(j^p)$ for $i \in \{pf, pm\}$, depending on age and sex. Out-of-pocket medical expenditures are defined similarly to $M_i^{oop} = \lambda_{j^p}^m M_i(j^p)$, where $\lambda_{j^p}^m$ is the co-payment rate of the health insurance depending on the age. The government covers the remaining fraction $(1 - \lambda_{j^p}^m)$ of gross medical expenditures.

Public Pension The government operates a pay-as-you-go public pension system. Individuals receive public pension benefits once they are in the older parent generation. Let $\text{pen}_i(j^p, z)$ denote the public pension benefits for individuals $i \in \{pf, pm\}$ with age j^p and permanent skill z. The benefits of male older parents are determined as follows.

$$\text{pen}_{pm}(j^p, z) = \kappa \frac{\bar{y}_m(z)}{J-1} \tag{2}$$

where κ is the public pension replacement rate and

$$\bar{y}_m = \begin{cases} y_{km}(j, z) & \text{if } j = 1 \\ y_{km}(j, z) + \bar{y}_{km}(j-1, z) & \text{if } 1 < j \leq J \\ \bar{y}_{km}(j-1, z) & \text{if } J < j \end{cases}$$

The benefits of female older parents depend on the average earnings of the skill group instead of the past individual earnings.[26]

$$\text{pen}_{pf}(j^p, z) = \kappa \frac{1}{J-1} \sum_{j=1}^{J} \mathbb{E}\left[\epsilon(j, z)\mu(j) \frac{1}{\overline{WH}_{kf}} \left(\overline{DH}_{kf} - \mathbb{1}_{h \in \{2,3\}} T(\phi_j) - l_j\right)\right] \tag{3}$$

Means-tested Welfare Transfer Program Individuals with low income and savings are eligible for the means-tested welfare program (i.e., *seikatsu-hogo*). This covers

[24]This study does not consider medical expenditures during the adult child stage. This is because average annual gross medical expenses during the adult child stage are relatively low. According to the National Medical Expenses of the MHLW in 2015, average annual gross medical expenses are close to 200,000 JPY until 50 years and subsequently increase, but until age 65, they are at most less than 400,000 and 500,000 JPY for females and males, respectively. Website: https://www.e-stat.go.jp/stat-search/files?stat_infid=000031622557 (in Japanese) (Accessed September 13, 2024).

[25]This study assumes that no correlation between LTC and medical expenditures. Suzuki et al. (2012) report no correlation between LTC and medical expenditures after controlling for inpatients and nursing home residents. They use the complete set of insurance claims data provided by public insurers of Fukui Prefecture in Japan.

[26]Although public pension benefits depend on past individual earnings in the actual economy, a substantial additional burden for computation arises when a new state variable, such as average lifetime earnings, is introduced. To keep the state space dimensions manageable, this study follows the formalization of Attanasio et al. (2010).

their minimum living expenses and their LTC and medical expenditures. A means-tested transfer tr is provided to guarantee a minimum consumption level $\underline{c}$ for each household in each generation. The minimum consumption level differs by marital status. The transfer amount for a family is given as follows.

$$tr = \max\left\{0, (1+\tau^c)(\underline{c}_k + \underline{c}_p) - \left(Ra + \sum_{i\in\{kf,km\}} (1-\tau^l)(1+\nu)y_i + \sum_{i\in\{pf,pm\}} (\text{pen}_i - M_i^{oop} - H_i^{oop})\right)\right\}$$

As in De Nardi et al. (2010), this study imposes that if transfers are positive, the family consumes all of its resources, that is, $a' = 0$.

Taxes The government imposes proportional taxes on consumption at rate τ^c, labor income at τ^l, capital income at τ^a, and lump-sum tax τ^{ls} on each individual. The net-of-tax gross return on capital is denoted as $R = 1 + (1-\tau^a)r$, where r is the interest rate. The government budget constraint is given as follows.

$$\tau^l Y_l + \tau^a Y_a + \tau^c(C_k + C_p) + \tau^{ls} N = SS + HI + LTC + TR + G \tag{4}$$

where Y_l, Y_a, C_k, and C_p denote aggregate labor income, capital income, and consumption for the adult child and older parent generation, respectively; N denotes the total number of individuals; SS, HI, LTC, and TR denote the total government expenditures for a public pension, public health insurance, public LTCI, and the means-tested welfare program, respectively; and G denotes the government's consumption expenditures.

In the baseline model, this study assumes that τ^{ls} is zero and lets G absorb the imbalance and satisfy equation (4) to isolate the effects of governmental LTC expenditure and focus on changes from different risks individuals face over the life-cycle. In the numerical experiments in Section 5, this study considers various policy scenarios and adjusts τ^{ls} to account for a change in the net government revenues to balance the government budget in equation (4).

3.8 Problem of Families

Families are heterogeneous in terms of the age of the adult child generation j^k, asset a, the skill of the older parent and adult child generation z, z', current LTC-status h and use of the NHC in the previous period ι_{-1} for the female older parent, and idiosyncratic wage shock μ for the female adult child. We summarize the state as $\mathbf{x} = \{j^k, a, z, z', h, \iota_{-1}, \mu\}$. We define the problem of families with the following six value functions, based on the current LTC-status h and previous residential arrangements ι_{-1} of the female older parent.

Value Function of No Parents The state variables of families are given as $(j^k, a, z, z', h = 4, \mu)$. Given these states, families optimally choose the allocation of consumption of the adult child generation c_k, leisure of a female in the adult child generation l_{kf}, and savings a' to maximize utility over the life-cycle. The value function is expressed as follows.

$$V_{j^k}^K(a,z,z',h=4,\mu) = \max_{c_k,l_{kf},a'} \left\{ u_k(c_k,l_{kf}) + \beta\, \mathbb{E}\, \tilde{V}_{j^k+1}(\mathbf{x}') \right\}$$

subject to

$$\begin{aligned} &(1+\tau^c)c_k + a' = Ra + (1-\tau^l)(1+\nu)(y_{kf}+y_{km}) + tr \\ &a' \geq 0 \end{aligned}$$

$$\mathbb{E}\, \tilde{V}_{j^k+1}(\mathbf{x}') = \begin{cases} \sum_{\mu'} \Lambda(\mu',\mu) V_{j^k+1}^K(a',z,z',h'=4,\mu') & \text{if } j^k < J \\ (1+\nu) \sum_{z''} \Omega_{z''|z'} \sum_{\mu'} \overline{\Lambda}(\mu') V_1^{ND}\left(\frac{a'}{(1+\nu)},z',z'',h'=1,\iota_{-1}=0,\mu'\right) & \text{if } j^k = J \end{cases}$$

Value Function of Heavy LTC-status in Public Nursing Homes The state variables of families are given as $(j^k,a,z,z',h=3,\iota_{-1}=1,\mu)$. Once families select NHC, their female older parents with disabilities spend the rest of their lives in the public NHC. Their families then pay both the cost of LTC services $\bar{q}$ and the fee for the use of the NHC $\bar{c}$, including the residence fee, food fee, and expenses of daily living.

$$V_{j^k}^{HI}(a,z,z',h=3,\iota_{-1}=0,\mu) = \max_{c_k,l_{kf},a'} \left\{ u_k(c_k,l_{kf}) + u_p(\bar{c}) + \beta\, \mathbb{E}\, \tilde{V}_{j^k+1}(\mathbf{x}') \right\}$$

subject to

$$\begin{aligned} &(1+\tau^c)(c_k+\bar{c}) + a' + H_{pf}^{oop} = Ra + (1-\tau^l)(1+\nu)(y_{kf}+y_{km}) + \text{pen}_{pf} - M_{pf}^{oop} + tr \\ &a' \geq 0 \end{aligned}$$

$$\mathbb{E}\, \tilde{V}_{j^k+1}(\mathbf{x}') = \begin{cases} \sum_{\mu'} \Lambda(\mu',\mu)[\Psi(h'=2 \mid h=3,j^p) V_{j^k+1}^{LI}(a',z,z',h'=2,\iota_{-1}=1,\mu') & \text{if } j^k < J \\ \qquad +\Psi(h'=3 \mid h=3,j^p) V_{j^k+1}^{HI}(a',z,z',h'=3,\iota_{-1}=1,\mu') \\ \qquad +\Psi(h'=4 \mid h=3,j^p) V_{j^k+1}^{K}(a',z,z',h'=4,\mu')] \\ (1+\nu) \sum_{z''} \Omega_{z''|z'} \sum_{\mu'} \overline{\Lambda}(\mu') V_1^{ND}\left(\frac{a'}{(1+\nu)},z',z'',h'=1,\iota_{-1}=0,\mu'\right) & \text{if } j^k = J \end{cases}$$

Value Function of Heavy LTC-status at Home The state variables of families are expressed as $(j^k,a,z,z',h=3,\iota_{-1}=0,\mu)$. The value function is expressed as follows.

$$\begin{aligned} &V_{j^k}^{HC}(a,z,z',h=3,\iota_{-1}=0,\mu) \\ &= \max_{\iota \in \{0,1\}} \left\{ (1-\iota)\left(\tilde{V}_{j^k}^{HC}(a,z,z',h=3,\iota_{-1}=0,\mu)\right) + \iota\left(V_{j^k}^{HI}(a,z,z',h=3,\iota_{-1}=0,\mu)+\xi\right) \right\} \end{aligned}$$

If families choose NHC in the next periods ($\iota=1$), see the value function of heavy LTC-status at home. If families choose at-home care services ($\iota=0$), families have to determine

both the allocated time for IC ϕ and the expenditures for FHC q to satisfy equation (1). Note that q is determined by minimizing out-of-pocket LTC expenditures when ϕ is given.

$$q^*(\phi) = \begin{cases} 0 & \text{if } (\chi(h)/A)^\rho - (1-\theta(h))(T(\phi)\times 365)^\rho \leq 0 \\ \left(\frac{(\chi(h)/A)^\rho - (1-\theta(h))(T(\phi)\times 365)^\rho}{\theta(h)}\right)^{\frac{1}{\rho}} p & \text{if } (\chi(h)/A)^\rho - (1-\theta(h))(T(\phi)\times 365)^\rho > 0 \end{cases}$$

Thereafter, the value function can be rewritten as follows.

$$\tilde{V}^{HC}_{j^k}(a,z,z',h=3,\iota_{-1}=0,\mu) = \max_{\phi\in\{0,1/8,1/2,1\}} \left\{ \max_{c_k,c_p,l_{kf},a'} \{u_k(c_k,l_{kf}) + u_p(c_p,\phi) + \beta\,\mathbb{E}\,\tilde{V}_{j^k+1}(\mathbf{x}')\} \right\}$$

subject to

$$(1+\tau^c)(c_k+c_p) + a' + H^{oop}_{pf} = Ra + (1-\tau^l)(1+\nu)(y_{kf}+y_{km}) + \text{pen}_{pf} - M^{oop}_{pf} + tr$$
$$a' \geq 0$$

$$\mathbb{E}\,\tilde{V}_{j^k+1} = \begin{cases} \sum_{\mu'} \Lambda(\mu',\mu)[\Psi(h'=2 \mid h=3,j^p)V^{LC}_{j^k+1}(a',z,z',h'=2,\iota_{-1}=0,\mu') & \text{if } j^k < J \\ \qquad +\Psi(h'=3 \mid h=3,j^p)V^{HC}_{j^k+1}(a',z,z',h'=3,\iota_{-1}=0,\mu') \\ \qquad +\Psi(h'=4 \mid h=3,j^p)V^{K}_{j^k+1}(a',z,z',h'=4,\mu')] \\ (1+\nu)\sum_{z''}\Omega_{z''|z'}\sum_{\mu'}\overline{\Lambda}(\mu')V^{ND}_1\left(\frac{a'}{(1+\nu)},z',z'',h'=1,\iota_{-1}=0,\mu'\right) & \text{if } j^k = J \end{cases}$$

Value Function of Light LTC-status in Public Nursing Homes and at Home Each value function is similar to the value function of the heavy LTC-status in public nursing homes and at home, respectively. See Appendix C.1.

Value function of No-Disability The state variables of families are given as $(j^k,a,z,z',h=1,\iota_{-1}=0,\mu)$. The value function is expressed as follows.

$$V^{ND}_{j^k}(a,z,z',h=1,\iota_{-1}=0,\mu) = \max_{c_k,c_p,l_{kf},a'} \left\{ u_k(c_k,l_{kf}) + u_p(c_p) + \beta\,\mathbb{E}\,\tilde{V}_{j^k+1}(\mathbf{x}') \right\}$$

subject to

$$(1+\tau^c)(c_k+c_p) + a' = Ra + (1-\tau^l)(1+\nu)(y_{kf}+y_{km}) + \sum \text{pen}_i - \sum M^{oop}_i - H^{oop}_{pm} + tr$$
$$a' \geq 0$$

$$\mathbb{E}\,\tilde{V}_{j^k+1}(\mathbf{x}') = \begin{cases} \sum_{\mu'} \Lambda(\mu',\mu)[\Psi(h'=1 \mid h=1,j^p)V^{ND}_{j^k+1}(a',z,z',h'=1,\iota_{-1}=0,\mu') & \text{if } j^k < J \\ \qquad +\Psi(h'=2 \mid h=1,j^p)V^{LC}_{j^k+1}(a',z,z',h'=2,\iota_{-1}=0,\mu') \\ \qquad +\Psi(h'=3 \mid h=1,j^p)V^{HC}_{j^k+1}(a',z,z',h'=3,\iota_{-1}=0,\mu') \\ \qquad +\Psi(h'=4 \mid h=1,j^p)V^{K}_{j^k+1}(a',z,z',h'=4,\mu')] \\ (1+\nu)\sum_{z''}\Omega_{z''|z'}\sum_{\mu'}\overline{\Lambda}(\mu')V^{ND}_1\left(\frac{a'}{(1+\nu)},z',z'',h'=1,\iota_{-1}=0,\mu'\right) & \text{if } j^k = J \end{cases}$$

3.9 Equilibrium

Given the interest rate r, and a set of government policies $\{\lambda^h, \lambda^m, \tau^c, \tau^a, \tau^l\}$, a stationary recursive competitive equilibrium is a set of six value functions $\{V^{ND}_{j^k}(\mathbf{x}), V^{LC}_{j^k}(\mathbf{x}), V^{LI}_{j^k}(\mathbf{x}), V^{HC}_{j^k}(\mathbf{x}), V^{HI}_{j^k}(\mathbf{x}), V^{K}_{j^k}(\mathbf{x})\}^J_{j^k=1}$, family decision rules $\{c_{k,j^k}(\mathbf{x}), c_{p,j^k}(\mathbf{x}), l_{kf,j^k}(\mathbf{x}), a_{j^k+1}(\mathbf{x}), \iota_{j^k}(\mathbf{x}), \phi_{j^k}(\mathbf{x}), q_{j^k}(\mathbf{x})\}^J_{j^k=1}$, time-invariant measures of families $X_{j^k}(\mathbf{x})$ with age-j^k families with the state vector $\mathbf{x} = \{a, z, z', h, \iota_{-1}, \mu\}$, and lump-sum transfer τ^{ls}, such that the following conditions are satisfied. See Appendix E for further details on the numerical procedures.

1. Given the factor prices and government policies, the family decision rules solve the family decision problems in Section 3.8.

2. The government budget is balanced in equation (4).

3. Individuals and aggregate behaviors are consistent as follows.

$$\begin{aligned} Y_l &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}}\left[y_{kf}(\mathbf{x}) + y_{km}(\mathbf{x})\right]X_{j^k}(\mathbf{x}) \\ &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}}\left[\frac{\epsilon(j^k,z')\mu(j^k)}{\overline{WH}_{kf}(j^k)}\left(\overline{DH}_{kf}(j^k) - \mathbb{1}_{h\in\{2,3\}}T(\phi_{j^k}) - l_{kf,j^k}(\mathbf{x})\right) + y_{km}(j^k,z')\right]X_{j^k}(\mathbf{x}) \\ Y_a &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} Ra_{j^k}(\mathbf{x})X_{j^k}(\mathbf{x}) \\ C_k &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} c_{k,j^k}(\mathbf{x})X_{j^k}(\mathbf{x}) \\ C_p &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} c_{p,j^k}(\mathbf{x})X_{j^k}(\mathbf{x}) \\ N &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}}\left[2 + n^p(j^p,h)\right]X_{j^k}(\mathbf{x}) \\ SS &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}}\left[\text{pen}_{pf}(j^p,z') + (n^p(j^p,h)-1)pen_{pm}(j^p,z')\right]X_{j^k}(\mathbf{x}) \end{aligned}$$

$$HI = \sum_{j^k=1}^{J} \sum_{\mathbf{x}} (1 - \lambda^m(j^p)) \left[M_{pf}(j^p) + (n^p(j^p, h) - 1) M_{pm}(j^p) \right] X_{j^k}(\mathbf{x})$$

$$LTC = \sum_{j^k=1}^{J} \sum_{\mathbf{x}} (1 - \lambda^h) \left[q^*_{j^k}(\mathbf{x}) + (n^p(j^p, h) - 1) H_{pm}(j^p) \right] X_{j^k}(\mathbf{x})$$

$$TR = \sum_{j^k=1}^{J} \sum_{\mathbf{x}} tr(\mathbf{x}) X_{j^k}(\mathbf{x})$$

4. The public pension benefit system is balanced in equations (2) and (3).

5. The set of age-dependent measures of families satisfies the following conditions:

   – For $j^k < J$,

$$\begin{aligned} & X_{j^k+1}(a', z, z', h', \iota, \mu') \\ =& \frac{1}{(1+\nu)^{1/J}} \sum_{\{a, h, \iota_{-1}, \mu : a', \iota\}} \Psi(h' \mid h, j^p) \Lambda(\mu', \mu) X_{j^k}(a, z, z', h, \iota_{-1}, \mu) \end{aligned} \tag{5}$$

   where a' and ι are the optimal choices in the later periods.

   – For $j^k = J$,

$$\begin{aligned} & X_1(a', z', z'', h' = 1, \iota = 0, \mu') \\ =& (1+\nu) \sum_{\{a, z, h, \iota_{-1}, \mu : a'\}} \Omega_{z''|z'} \overline{\Lambda}(\mu') X_J(a, z, z', h, \iota_{-1}, \mu) \end{aligned} \tag{6}$$

   where a' is the optimal choice in the next periods.

4 Calibration

This section describes the calibration of the model parameters. We calibrate the steady state economy to Japanese economy in 2015. The parameters in this model are divided into two categories. In the first category, those are external parameters directly estimated from the data and existing literature. Those in the second group are internal parameters calibrated by matching model-generated targets' values to their data counterparts.

4.1 External Calibration

We turn to parameters that we estimate directly from the data and existing literature. The parameters and values are summarized in Table 4.

Demographics We let individuals enter the economy at age $j = 1$, corresponding to 35 years old. We set the age difference between an adult child generation and an older parent generation as 30 years because the average age difference between mothers and children from 1975–2015 is 30 years according to the Vital Statistics of the MHLW in 2019. Further, individuals retire from the labor market at 65 years and live to the maximum possible age of 94. We set the annual population growth rate at zero. The equivalence scale η adjusts the consumption of each generation according to the size of the household, which assigns $\eta(n) = 1 + 0.7(n-1)$ to the size of the family n, following Bick and Choi (2013).

Long-Term Care and Medical Expenditure Risk We use transition probabilities Ψ by age, sex, and LTC-status, which are estimated by Mikoshiba et al. (2024), as described in Section 3.3. This study assumes that the number of household members in the older parent generation $n^p(j^p, h)$ depends on both age and LTC-status. The deterministic measure of the male older parent $n^p(j^p, h = 1) - 1$ is calibrated based on their survival probabilities, estimated in Mikoshiba et al. (2024).

As shown in Figure 1b, we calculate the average annual gross LTC expenditures per capita for male older parents H_{pm} from the SLBE of the MHLW in 2015 and the Population Statistics of Japan of the NIPSSR in 2017.[27] Further, we calculate the average annual gross medical expenditures for older parents $M_i(j^p)$ for $i \in \{pf, pm\}$ from the National Medical Expenses (NME) of the MHLW in 2015.

Skill The transition probability of skill inheritance Ω is calibrated to match both the proportion of high-skilled individuals in the working-age population and the correlation between the income of children and parents, as in İmrohoroğlu and Zhao (2018). The proportion of high-skilled individuals is 31%, as reported by the Employment Status Survey (ESS) of the MIC in 2017. We use the estimated value of the correlation between children's and parents' income from Lefranc et al. (2014). The transition probabilities of skill inheritance are given as follows.

$$\Omega = \begin{bmatrix} \Omega_{LL} & \Omega_{LH} \\ \Omega_{HL} & \Omega_{HH} \end{bmatrix} = \begin{bmatrix} 0.80 & 0.20 \\ 0.45 & 0.55 \end{bmatrix}$$

where the generic element $\Omega_{zz'}$ with $z, z' \in \{L, H\}$ is the probability of the transition of inherited skills from the older parent generation with skill z to the adult child generation with skill z'. In the steady state, the distribution of skill combinations between the older parent generation and the adult child generation is 54.90%, 13.95%, 13.95%, and 17.21% for LL, HL, LH, and HH, respectively.

[27] The Population Statistics of Japan 2017 provides the annual population by age and sex in 2015. Website: https://www.ipss.go.jp/syoushika/tohkei/Popular/Popular2017RE.asp?chap=0 (Accessed September 13, 2024).

Endowments The age-specific deterministic labor productivity $\epsilon(j^k, z)$ for the working-age married females is calibrated from their earnings based on the ESS of the MIC in 2017. Figure 3 shows the life-cycle earnings profiles for the working-age married females by age and skill to calibrate their labor productivity. High-skilled married females earn more over working-age than low-skilled married. Many female workers leave the labor force at child-bearing age and return to work after several years, resulting in the so-called "M-shaped" patterns.

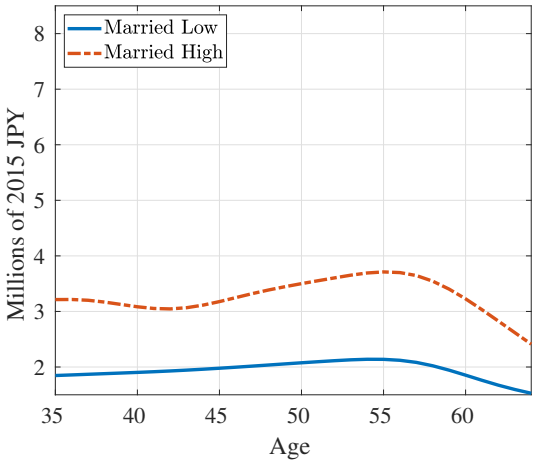


Figure 3: Earnings of Married Females by Age and Skill

Note: The married sample includes both widowed and divorced individuals. We define individuals as high-skilled if they have a college or higher degree and low-skilled otherwise. The data are obtained from the Employment Status Survey (ESS) of the Ministry of Internal Affairs and Communications (MIC) in 2017. We use the data from 2017 and adjust them to the 2015 level using the consumer price index.

To capture the labor supply at the extensive and intensive margins of married females, this study introduces both average working hours $\overline{WH}_{yf}(j^k)$ and disposable income $\overline{DH}_{yf}(j^k)$ for married females across ages. We normalize disposable time to 1.0 and calibrate the average working hours using the Time Use Survey of the MIC in 2016. For idiosyncratic wage shocks, we discretize the AR(1) process into a three-state Markov chain, as in Tauchen (1986). Following Hsu and Yamada (2019), we take $\Theta = 0.98$ and variance $\sigma_\zeta = 0.09$. The resulting value of μ and $\overline{\Lambda}(\mu)$ are follows.

$$\mu \in \{0.40, 1.00, 2.47\}, \quad \overline{\Lambda}(\mu) \in \{0.21, 0.58, 0.21\}$$

The inelastic labor supply for working-age married males is calibrated from their average earnings, computed by multiplying earnings and labor force participation, using the ESS of the MIC in 2017.[28] As shown in Figure 4, the average earnings of married males $y_{km}(j^k, z)$ vary deterministically with age and skill. Compared to Figure 3, there are

[28]Figure D.1a and D.1b in Appendix D shows the life-cycle profiles of earnings and labor force participation for the working-age married males by age and skill.

large differences in earnings by sex and skill levels. Regardless of skill level, male earnings are much higher than female earnings. High-skilled married males earn the most.

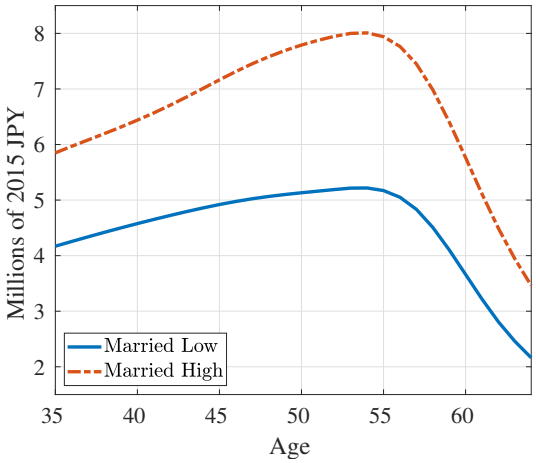


Figure 4: Average Earnings of Married Males by Age and Skill

Note: Average earnings are calculated by multiplying earnings by the labor force participation of married males. The married sample includes both widowed and divorced individuals. We define individuals as high-skilled if they have a college or higher degree and as low-skilled otherwise. The data are obtained from the Employment Status Survey (ESS) of the Ministry of Internal Affairs and Communications (MIC) in 2017. We use the data from 2017 and adjust them to the 2015 level using the consumer price index.

The leisure of the male adult child, the male older parent, and the female older parent is calculated using the Time Use Survey of the MIC in 2016. The values obtained are 0.54, 0.54, and 0.50, respectively.

Care Arrangements For the cost of NHC services, we use the Survey of Institutions and Establishments for Long-term Care (SIEL) of the MHLW in 2016. The SIEL reports the average cost for different types of expenditures for NHC services covered under LTCI by different levels of care. We calculate the weighted average cost of NHC services $\bar{q}$ and the weighted average fee $\bar{c}$ for the welfare care facilities for the elderly (special nursing homes). We set them at 327.83 and 121.20 (10,000-JPY, CPI adjusted to 2015), respectively. [29] Since NHC recipients in the facility must pay for their living costs, we calculate the weighted average living costs $\bar{c}$ as the sum of the residence fee, food fee, and daily living expenses.[30]

[29]Data are available at: https://www.mhlw.go.jp/toukei/saikin/hw/kaigo/service16/dl/data28.xlsx (in Japanese) (Downloaded on July 10, 2022).

[30]The average residence fee is set at 58.83 (10,000-JPY) as the average standard amount of residence fee by different types of institutions. The average food fee is set at 50.37 (10,000-JPY) by the standard amount of the food fee, and the living cost is set at 12.00 (10,000-JPY). For details on the standard amount of living costs, see, for example, https://www.kaigokensaku.mhlw.go.jp/commentary/fee.html (in Japanese) (Accessed September 13, 2024).

For the parameters of at-home care, the average cost of FHC per hour p and the minimum requirement of total care hours $\chi(h)$ are calibrated directly from the CSLC in 2016, using information on the IC and FHC services hours and monthly expenditures on FHC services for the care sample. We calculate the average cost of FHC per hour p as 0.176 (10,000-JPY, CPI adjusted to 2015), using the information on time and monthly expenditures for FHC services. As the minimum requirement of total care hours, we calculate average annual total care hours as 1424.83 and 3094.82 hours for the light and heavy LTC-status, respectively. Annual total care hours are the sum of annual IC and FHC hours, computing the average annual FHC hours by the total expenditures and the average cost of FHC per hour.

Preference The coefficient of relative risk aversion σ is set at 3.0, which is in the range of values used in the literature. For example, De Nardi et al. (2016) set the risk aversion at 2.83 by the model estimation.

Government The government operates the public LTCI, public health insurance, pay-as-you-go public pension, and means-tested welfare transfer program. The copayment rate of the LTCI λ^h is set to 10% for all ages. The LTCI covers 90% of the LTC expenditures for both FHC and public NHC services. The public health insurance also covers part of the medical expenditure, and its copayment rate λ^m_{jp} varies with age. We set λ^m_{jp} at 30%, 20%, and 10% for those aged 69 years and below, between 70 and 74, and above 75, respectively. The pension replacement rate κ is set at one-third, based on the OECD (2019)'s estimated average gross replacement rate of public pensions.

The means-tested welfare program of my model provides means-tested transfers to eligible families. The consumption floor is set at 87 and 132 (10,000-JPY) for widowed and married couples, respectively. The amount is set to be within the range of average public assistance payments according to the family size,[31] and adjusted to match the average coverage, 1.67% of the population.

We set the consumption tax rate τ^c at 8% based on the tax rate in 2015. Furthermore, we set the labor tax rate τ^l and capital tax rate τ^a at 30% and 35%, respectively, based on Gunji and Miyazaki (2011) and Kitao and Mikoshiba (2020)—consistent with the literature estimates of effective income tax rates.

Factor Price This model is a partial equilibrium model, assuming that the interest rate r is exogenous. We set the interest rate to 2% based on Aoki et al. (2016).

[31] For more details on the welfare program, see, for example, https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/kijun23_05.pdf (in Japanese) (Accessed September 13, 2024).

Table 4: Exogenously Calibrated Parameters

Parameter	Description	Values / Source
Demographics		
J	Lifetime span	30
ν_g	Population growth rate	0%
η	Equivalence scale	Bick and Choi (2013)
Disability and Mortality risks, and Long-Term Care and Medical Expenditures		
Ψ	Transition matrix of LTC-status	Mikoshiba et al. (2024)
$n^p(j^p, h)$	# of household members	Mikoshiba et al. (2024)
$H_{pm}(j^p)$	Avg. gross LTC expenditure	SLBE and Population Statistics data
$M_i(j^p)$	Avg. gross medical expenditure	NME data
Endowments		
Ω	Skill inheritance transition	Lefranc et al. (2014) and ESS data
$\epsilon(j^k, z)$	Avg. earnings of married females	ESS data
$\overline{WH}_{yf}(j^k)$	Avg. working hour	Time Use Survey data
$\overline{DH}_{yf}(j^k)$	Avg. disposal hour	Time Use Survey data
Θ	Persistence of wage shock	0.98 by Hsu and Yamada (2019)
σ_ζ	Variance of wage shock	0.09 by Hsu and Yamada (2019)
$y_{km}(j^k, z)$	Avg. earnings of married males	ESS data
$\bar{l}_{km}, \bar{l}_{pm}, \bar{l}_{pf}$	Avg. leisure time	{0.54, 0.54, 0.50} by Time Use Survey data
Care Arrangement		
$\bar{q}$	Avg. formal care cost in facility	327.83 (10,000-JPY) by SIEL data
$\bar{c}$	Avg. livings costs in facility	121.20 (10,000-JPY) by SIEL data
p	Avg. cost of FHC per hour	0.176 (10,000-JPY) by CSLC data
χ_h	Min. requirement of care hours	{1424.83, 3094.82} by CSLC data
Preference		
σ	Risk aversion parameter	3.0
Government		
λ^h	LTCI copay	10%
$\lambda^m_{j^p}$	Public health insurance copay	30, 20, 10% (varies by age)
κ	Pension replacement rate	1/3 by OECD (2019)
$\underline{c}$	Consumption floor	87 (10,000-JPY) for widowed 123 (10,000-JPY) for married
τ^c	Consumption tax rate	8%
τ^l	Labor income tax rate	30% by Gunji and Miyazaki (2011)
τ^a	Capital income tax rate	35% by Kitao and Mikoshiba (2020)
Other Parameters		
r	Interest rate	2% by Aoki et al. (2016)

4.2 Internal Calibration

The remaining parameters to be determined are preferences and care arrangements. We calibrate them by matching model-generated targets with their corresponding data. This study minimizes a simple residual sum of squares. Table 5 summarizes the description and values of the parameters.

For the subjective discount factor β, we use the data from Kitao and Yamada (2019), which use the National Survey of Family Income and Expenditure (NSFIE) of the MIC in 2014. We set the parameter to ensure that the model achieves the average per adult equivalent wealth of 823.93 (10,000-JPY, CPI adjusted to 2015). We set the intensity of leisure in the utility function γ to correspond to the average labor force participation of working-age married males, which is 70.71%. We use the 2017 ESS data provided by the MIC. The calibrated value of γ is in the range of values estimated in the literature, such as Fuster et al. (2007) at 0.63 and Gao (2020) at 0.42.

Next, we calibrate six parameters about care arrangements. The data on care arrangements are obtained from the CSLC in 2016. The average annual LTC hours help identify the parameter of returns to care input hours A. For the substitution between IC and FHC, we use the correlation between IC and FHC hours ρ and the rate of IC hours in total care hours by LTC-status $\theta(h)$. For the correlation between IC and FHC hours, we group the eligible older adults by the quartile of FHC hours, as in Daruich (2018). The rate of those who use only IC is to calibrate preference for IC ω. The preference for NHC ξ is calibrated to the share of nursing home users among those with heavy LTC-status.

Table 5: Jointly Estimated Parameters

Parameter	Value	Moment	Data	Model
Preferences				
β	0.98	Avg. per adult equivalent wealth (10,000-JPY)	823.93	819.73
γ	0.51	Avg. female labor force participation rate	0.70	0.69
Care Arrangements				
A	3.40	Avg. annual care hours	1904.00	1851.73
ρ	0.33	IC-FHC hours correlation	-0.32	-0.38
$\theta(h=2)$	0.44	IC hours rate in total (Light LTC-status)	0.60	0.82
$\theta(h=3)$	0.87	IC hours rate in total (Heavy LTC-status)	0.48	0.57
ω	3.19	Rate of those who use only IC	0.18	0.17
ξ	4.81	Rate of recipients at home	0.61	0.57

5 Quantitative Analysis

In this section, we present the numerical results of the quantitative analysis. First, we review and discuss the results of the baseline model. We then analyze the roles of LTCI. This study evaluates how the universal LTCI with benefit-in-kind policy affects individuals' behavior and welfare by simulating policy experiments.

5.1 Baseline Model

Table 6 shows the distribution of care arrangements at home by LTC-status in the data and the baseline model. The calibrated model replicates the overall pattern of care arrangements.

Table 6: Distribution of Care Arrangements at home: Data and Baseline Model

		Data	Model
Aggregate	Distribution		
	Only IC	18.06%	17.32%
	Mix IC-FHC	75.42%	78.85%
	Only FHC	6.52%	3.83%
	Total Care Hours	1904.00	1851.73
Light (SL1-CL2)	Distribution		
	Only IC	20.87%	22.80%
	Mix IC-FHC	74.49%	77.20%
	Only FHC	4.64%	0.00%
	Total Care Hours	1424.83	1620.90
Heavy (CL3-CL5)	Distribution		
	Only IC	10.10%	0.00%
	Mix IC-FHC	78.05%	84.08%
	Only FHC	11.85%	15.92%
	Total Care Hours	3094.82	2580.26

Table 7 shows the distribution of care arrangements by family types in the baseline model. Family types depend on the skill combinations of the older parent generation z and the adult child generation z' in the baseline. For the ratio of IC hours, higher ratios are found for the low-skilled adult child generation and the high-skilled older parent generation. This is because the skill affects two key mechanisms that determine care arrangements: the opportunity cost of IC and the family saving amount.

Table 7: Distribution of Care Arrangements by Family Types in the Baseline Model

	Family Type (Skill Combinations)			
	HL	HH	LL	LH
IC hours / total care hours	82.49%	79.23%	75.07%	69.39%
Avg. per adult equivalent wealth (10,000-JPY)	1446.63	1836.33	379.29	672.02

The level of opportunity cost is determined by permanent labor productivity and idiosyncratic wage shocks. Since high-skilled individuals have higher permanent labor productivity, low-skilled individuals incur lower opportunity costs.

In the two-sided altruism model, the cost of choosing IC services becomes lower for families with the high-skilled older parent generation. This is because older parents can increase the future resources of their descendants by leaving their bequests, and adult children can prevent the reduction of bequests from their older parents by providing IC services. As shown in the last row, the amount of family savings depends on the skill level of the older parent generation, as the adult children generation joins a family line with zero assets. Higher family savings lead to higher consumption levels, and families increase their overall utility by leaving larger bequests for their descendants. In other words, families with sufficient savings decline current labor earnings through IC rather than smaller bequests due to reduced savings from FHC services. This is consistent with facts in Figure 2.

5.2 Policy Experiments

We conduct counterfactual policy experiments to evaluate the welfare effects of the universal LTCI with an in-kind benefits policy. We simulate the model under different scenarios from the baseline and compare the results. The welfare measure is calculated as the percentage change in consumption required in all possible states, ensuring that individuals are indifferent between the baseline and simulated scenarios.

In each scenario, we initially do not adjust the lump-sum transfer. Instead, we set G to absorb the imbalance and satisfy the government budget constraint (4). This isolates the effects of tax adjustments and focuses on changes in the behavior of heterogeneous families. Subsequently, we adjust the lump-sum transfer to account for a change in net government revenue to balance the budget constraint.

5.2.1 In-Kind Transfers versus Cash Transfers

Japan's LTCI exclusively covers the cost of FC services through in-kind transfers. This raises the question: Do the benefits of in-kind transfers surpass those of cash transfers? We first simulate an alternative scenario in which LTCI provides only cash benefits under

a copayment rate of 100%. We set the total government expenditure for cash benefits equal to that of LTCI in the baseline model. Specifically, the cash benefit amounts are set to match the baseline's total government spending for each LTC status, which are 32.70 and 207.36 (10,000-JPY) for light and heavy LTC statuses, respectively.[32]

Table 8 presents the changes in the aggregate variables of families' behavior and the welfare effects of heterogeneous families. The first row shows the result under no lump-sum tax adjustment. Due to the higher cost of purchasing FC services, the use of IC services at home increases along both the extensive and intensive margins. The NHC services also become comparatively more expensive, leading families to opt for at-home care. The increased reliance on IC reduces the labor force participation of married females, consistent with findings (e.g., Fu et al. 2017). Moreover, cash transfers compensate for the reduction in caregivers' labor income, thereby reducing families' incentive to save. With this compensation, the number of means-tested welfare transfer recipients becomes lower than in the baseline model. As a result, the welfare effects without lump-sum tax adjustment would be positive for all combinations of skill types.

Table 8: Welfare Effects of Cash Benefits

		No tax change	Tax adjusted
Average Change	IC users rate	3.83%pt	3.83%pt
	IC hrs rate	12.08%pt	12.07%pt
	At-home rate	30.84%pt	30.83%pt
	FLFP	-2.10%pt	-2.08%pt
	Savings	-3.43%	-3.42%
	Welfare recipients	1.67% → 1.27% (-0.39%pt)	1.67% → 1.28% (-0.39%pt)
	Lump-sum tax (JPY)		1635.05
Welfare Effects	Average	0.42%	0.38%
	By Family Type		
	LL = (Low, Low)	0.45%	0.40%
	LH = (Low, High)	0.50%	0.47%
	HL = (High, Low)	0.30%	0.26%
	HH = (High, High)	0.31%	0.29%

Note: The table presents the changes in variables relative to those in a baseline model.

With tax adjustment, the second row shows that cash benefits require about 1,600 JPY per individual. The increased use of IC services and decreased savings reduce tax revenue from the labor income of working-age married females and from capital income, thereby

[32]The same calculations are made for the cash benefit amount for male older parents when $h = 1$.

resulting in a lump-sum tax. Note that the lump-sum tax amount is extremely modest due to the lower labor productivity of married females. This leads to a slight mitigation of the positive welfare effects, which persist even after the lump-sum tax is imposed. This experiment suggests that cash transfers would be more efficient than in-kind transfers in improving overall welfare. The limited impact of the reduction in tax revenue indicates that positive welfare effects can be maintained even if government expenditures on LTCI are reduced.

We next analyze policy experiments in which the government reduces spending on LTCI by 5% and 15%, comparing the results to those of the baseline model. Table 9 shows the welfare effects of cash benefits under these LTCI spending cuts. Cash benefits are reduced by 5% and 15% for each LTC-status.

Table 9: Welfare Effects of Cash Benefits under LTCI Expenditure Cuts

	5% LTCI spending reduction		15% LTCI spending reduction	
	No tax change	Tax adjusted	No tax change	Tax adjusted
Average Change				
IC users rate	3.83%pt	3.83%pt	3.83%pt	3.83%pt
IC hrs rate	12.01%pt	12.00%pt	11.93%pt	11.91%pt
At-home rate	29.94%pt	29.88%pt	28.64%pt	28.44%pt
FLFP	-1.99%pt	-1.97%pt	-1.96%pt	-1.90%pt
Savings	-3.01%	-2.98%	-2.10%	-2.03%
Welfare recipients	1.67% → 1.37% (-0.30%pt)	1.67% → 1.38% (-0.28%pt)	1.67% → 1.52% (-0.15%pt)	1.67% → 1.56% (-0.10%pt)
Lump-sum tax (JPY)		2573.98		4398.56
Welfare Effects				
Average	0.26%	0.17%	-0.06%	-0.25%
By Family Type				
LL = (Low, Low)	0.28%	0.17%	-0.07%	-0.28%
LH = (Low, High)	0.35%	0.27%	0.05%	-0.12%
HL = (High, Low)	0.16%	0.07%	-0.12%	-0.29%
HH = (High, High)	0.19%	0.13%	-0.05%	-0.19%

Note: The table presents the changes in variables relative to those in a baseline model.

Compared to Table 8, reductions in labor force participation and savings are mitigated by decreased government expenditures. Welfare effects remain positive even when cash transfers are reduced by 5%. Although there is a slight increase in the number of welfare recipients, their proportion is lower than in the baseline. The second and fourth columns also indicate that tax adjustment effects remain small. Conversely, welfare effects decline as cash transfers are reduced, becoming negative with a 15% reduction.

These experiments suggest that welfare effects can be maintained while reducing government spending through cash transfers, given the limited impact of reduced tax revenues

from cash benefits. However, it should be noted that these values may represent upper bounds, as countries that have implemented cash transfers, such as Germany, cover costs for screening and monitoring recipients of cash transfers to prevent moral hazard.

5.2.2 Universal Insurance versus Mean-Tested Welfare Program

This study also examines the role of universal LTCI in comparison to the means-tested welfare program. We simulate an extreme scenario in which universal LTCI is removed from the baseline model, making the means-tested welfare program the only policy covering LTC expenses.[33] Table 10 presents the changes in aggregate variables and the welfare effects across heterogeneous families.

Table 10: Welfare Effects of Removing LTCI from Baseline

		No tax change	Tax adjusted
Average Change	IC users rate	3.83%pt	3.83%pt
	IC hrs rate	12.84%pt	13.05%pt
	At-home rate	8.44%pt	10.40%pt
	FLFP	-1.16%pt	-2.04%pt
	Savings	1.36%	1.92%
	Welfare recipients	1.67% $\rightarrow$ 4.00%	1.67% $\rightarrow$ 3.63%
		(2.33%pt)	(1.97%pt)
	Lump-sum tax (JPY)		-43315.03
Welfare Effects	Average	-2.71%	-0.48%
	By Family Type		
	LL = (Low, Low)	-2.89%	-0.48%
	LH = (Low, High)	-2.62%	-0.61%
	HL = (High, Low)	-2.53%	-0.41%
	HH = (High, High)	-2.20%	-0.41%

Note: The table presents the changes in variables relative to those in a baseline model.

Without lump-sum tax adjustments, both the intensive and extensive margins of IC services at home increase due to the higher cost of FC services. This additional increase leads to a reduction in the labor force participation of working-age married females. Simultaneously, families save more against disability risks. However, higher expenditures would hit families with lower savings, resulting in an increase in welfare transfer recipients. Consequently, welfare effects would be strictly negative without lump-sum tax adjustments.

[33] Even if the public LTCI is removed from the economy, this study assumes that the LTC market for FC services still exists.

When adjusting lump-sum transfers to balance the government budget constraint, each family member receives nearly 43,000 JPY annually. Despite this compensation, welfare effects remain strictly negative, even if a lump-sum subsidy is provided. This occurs because the reduction in government expenditures from eliminating universal LTCI would be partially offset by increased spending on the means-tested welfare program. The compensation provided through lump-sum subsidies would therefore be insufficient to cover significant LTC burdens.

However, it should be noted that this result depends on the generosity of the welfare program, as measured by the level of the consumption floor. As shown in Table 11, tax-adjusted welfare effects are positive when the consumption floor decreases. In an economy with a lower consumption floor, the reduction in government spending from eliminating universal LTCI would be less offset, as additional spending on the means-tested welfare program becomes comparatively smaller.

Table 11: Welfare Effects of Removing LTCI from Different Economies

	Baseline		Cons. Floor 20% down	
	No change	Adjusted	No change	Adjusted
Average	-2.71%	-0.48%	-2.58%	0.68%
By Family Type				
LL = (Low, Low)	-2.89%	-0.48%	-2.88%	0.68%
LH = (Low, High)	-2.62%	-0.61%	-2.37%	0.51%
HL = (High, Low)	-2.53%	-0.41%	-2.20%	0.82%
HH = (High, High)	-2.20%	-0.41%	-1.82%	0.69%
Lump-sum tax (JPY)		-43,315.03		-62,604.30

Note: The table presents the changes in welfare effects of removing universal LTCI relative to those in an economy with universal LTCI, respectively. The column labeled "No change" represents the change without the tax adjustment, and the column labeled "Adjusted" represents the change with the tax adjustment.

6 Conclusion

This study quantifies the welfare effects of LTCI on heterogeneous families as compared to alternative policies and focuses on the role of universal LTCI with in-kind transfers. This study is based on the Japanese economy, which has the highest aging rate in the world, and constructs a life-cycle model of family decision-making under LTC risks. We develop a structural overlapping generations model with two-sided altruism. Based on empirical evidence on LTC risks and care arrangements, our model focuses on the LTC-status of females in the older parent generation and the care arrangements between female older

parents and their female adult children as their primary caregivers. We incorporate three types of care options: IC services from their adult children at home, FHC services at home, and public NHC services.

This study examines two key features of Japan's LTCI system: mandatory universal insurance and a benefits-in-kind policy. This study provides two important insights. First, the welfare effects of in-kind and cash transfers depend on the labor productivity of caregivers. The universal LTCI with cash transfers is more efficient than that with in-kind transfers, despite the positive impact of the in-kind policy on caregiver labor supply. If caregiver labor productivity is very low, the decrease in tax revenue from labor income taxes is modest. Cash transfers could thereby sustain positive welfare effects while reducing government spending on LTCI. Second, the welfare effects of eliminating the universal LTCI system depend on the generosity of the welfare program. Without universal LTCI, families face a significant caregiving burden, relying on IC or the means-tested welfare program. The reduction in government spending on universal LTCI would then be redistributed to families as a lump-sum subsidy. However, the size of the subsidy would depend on the welfare program's generosity, as reduced LTCI spending would be partially offset by increased expenditures on the welfare program.

Our study has some limitations that can be addressed in future research. The first concern is the transition dynamics associated with demographic changes. This study considers a steady state economy and focuses on care arrangements between widowed females and their working-age female children. However, family structures have been evolving due to declining fertility rates, delayed marriages, and a declining trend in daughters-in-law as primary caregivers (e.g., Tokunaga et al. 2015). It is important to consider how these demographic changes affect welfare effects and fiscal sustainability. Moreover, this study does not incorporate the heterogeneity of preferences for LTC services. Demographic changes and the perceived availability of LTCI would affect preferences for each generation, which in turn interact with life-cycle behaviors and welfare evaluations.

Second, this study does not capture general equilibrium effects. This study considers a partial equilibrium and focuses on family behaviors. Since universal LTCI with in-kind benefits would increase the working-age population and the demand for FC services, expanding the model to include labor market and LTC market interactions would provide a more comprehensive understanding of its effects on the overall macroeconomy.

Third, this study does not consider the role of private NHC services in the LTC market. Given the growing inequality in income and wealth, analyzing how public NHC services interact with private NHC services in LTC markets would be important and should be pursued in future research.

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A More Details of the LTCI System

This section provides a more detailed description of the public LTCI system in Japan.

Purpose The insurance system was introduced to help older adults with disabilities maintain dignity and an independent daily life routine according to each individual's abilities.[34] According to the literature,[35] the insurance system also aims to (i) relieve the burden on family caregivers, (ii) emphasize at-home care rather than institutional care, (iii) allow consumers the free choice of providers to enhance consumer choice and competition, and (iv) separate LTC from health insurance coverage while unifying financing to integrate health and social services.

Eligibility Insured persons are categorized into two groups: Category-I insured persons, who are 65 years and older, and Category-II insured persons, who are between 40 and 64 years of age and insured through the health insurance system. Category-I insured persons are only eligible for LTCI services if they receive certification of needing care or support, regardless of the cause. In contrast, Category-II insured persons can access the LTCI services only if they are certified due to specific age-related diseases, such as early-onset dementia and cerebrovascular disease.

Recipients of the welfare transfer program who are 65 years and above are eligible for LTCI-covered care services upon certification of needing care or support. LTCI premiums for welfare recipients aged 65 or over are financed through livelihood assistance. Out-of-pocket LTC service expenditures for welfare recipients aged 65 or over are covered by long-term care assistance. In contrast, welfare transfer program recipients between the ages of 40 and 64 are not included in Category-II insured persons. Welfare recipients aged 40-64 years do not pay LTCI premiums. However, welfare recipients aged between 40 and 64 years are eligible for care services only if they are certified as needing care or support due to specific age-related diseases. Total LTC service expenditures for welfare recipients aged 40-64 years are covered by long-term care assistance.

Levels of Care The insurance system quantifies the level of care demanded by calculating the standard hours of total care required. Standard hours of care are estimated based on responses to a 74-item questionnaire on ADL, IADL, behavioral and psychological symptoms of dementia (BPSD), functional training, and medical care. Based on standard hours of care, the insurance system categorizes each older adult into one of eight levels of care needs by a computer algorithm and an expert committee. Table A.1

[34] According to the Long-term Care Insurance Act (*Kaigo hoken hō*) from the Ministry of Justice. See the description on the website, https://www.japaneselawtranslation.go.jp/ja/laws/view/3807 (Accessed November 30, 2024).

[35] See, for example, Campbell and Ikegami (2000) and Tamiya et al. (2011).

shows standard hours and approximate conditions by eight levels of care demanded. The standard hours are calculated to estimate the required level of care and do not represent the actual time the insurance provides care services. Additionally, Table A.1 shows the tabulation of activities and conditions for which more than 80% of respondents required some assistance at each level of care, based on 74-item questionnaires. These do not correspond to activities and conditions defined for each level of care.

Table A.1: Standard Hours (t minutes) and Approximate Conditions by Care Levels

Activity/Condition Requiring Some Assistance	SL1 $25 \leq t < 32$	SL2 · CL1 $32 \leq t < 50$	CL2 $50 \leq t < 70$	CL3 $70 \leq t < 90$	CL4 $90 \leq t < 110$	CL5 $110 \leq t$
Getting up on their own	✓	✓	✓	✓	✓	✓
Standing up on their own	✓	✓	✓	✓	✓	✓
Standing on one leg		✓	✓	✓	✓	✓
Shopping		✓	✓	✓	✓	✓
Daily decision-making		✓	✓	✓	✓	✓
Walking			✓	✓	✓	✓
Bathing/Showering			✓	✓	✓	✓
Clipping their own fingernails			✓	✓	✓	✓
Managing medications			✓	✓	✓	✓
Managing finances			✓	✓	✓	✓
Preparing simple meals			✓	✓	✓	✓
Turning over while sleeping				✓	✓	✓
Controlling bladder function				✓	✓	✓
Controlling bowel function				✓	✓	✓
Oral hygiene				✓	✓	✓
Dressing/Undressing				✓	✓	✓
Holding a sitting position					✓	✓
Standing on both legs					✓	✓
Transferring/Moving around					✓	✓
Facial cleansing/Hairdressing					✓	✓
Eating meals						✓
Short-term memory						✓
Paralysis (left lower extremity)						✓

Source: https://www.mhlw.go.jp/file/05-Shingikai-11901000-Koyoukintoujidoukateikyoku-Soumuka/0000126240.pdf (in Japanese, page 10 and 11) (Accessed September 13, 2024).

Reassessments Reassessments are conducted annually once individuals have been certified as eligible for LTCI. For those who are initially certified, reassessments occur six months after the initial certification. Individuals can request reassessments if they experience a reduction in disability or have questions regarding the assessment results. For more details on the process, see Tsutsui and Muramatsu (2005).

B More Details of the CSLC data

This section provides more details of the CSLC data.

Data The CSLC is a nationally representative repeated cross-sectional micro survey of the non-institutionalized population conducted by the Ministry of Health, Labour and Welfare (MHLW). The CSLC covers families and family members nationwide.[36] The CSLC consists of five questionnaires: household, long-term care, health, income, and savings questionnaires. The CSLC annually conducts the household and income questionnaires; however, the long-term care, health, and savings questionnaires are conducted only once every three years during the large-scale survey year.

For research purposes, this study mainly uses household and long-term care questionnaires from the 2016 large-scale survey.[37] The 2016 household questionnaires cover approximately 710,000 individuals, randomly sampled from 5,410 districts as recorded in the 2010 National Census. The 2016 long-term care questionnaires supplement the household questionnaires by including approximately 8,000 LTCI-certified individuals from 2,446 of the 5,410 districts sampled in the household questionnaires.

This study constructs a dataset by matching household questionnaires with long-term care questionnaires, with the approval of the MHLW. The household questionnaire provides key information about families and their members, including details on family structure, age, sex, and care demand. Meanwhile, the long-term care questionnaire contains information on care demand, including certifications for care or support, levels of care, types of care services, and associated costs.

Care Sample The care sample is constructed from the CSLC by matching household questionnaires with long-term care questionnaires. The sample includes individuals eligible for LTCI services, aged between 65 and 94 years, but is limited to those who provide information on the level of care and primary caregivers. Table B.1 displays the characteristics of older adults with disabilities who receive care at home.

[36] The following individuals are not covered by the CSLC: single workers; migrant workers; long-term business travelers (generally those staying for more than three months); students on leave; residents of nursing homes; long-term hospitalized patients (those whose resident registration has been transferred to a hospital); foster children in care; incarcerated persons; and other separated individuals.

[37] This study additionally uses saving questionnaires to obtain information on savings in Figure 2. Since the saving questionnaires can not be matched with long-term care questionnaires, this study matches saving questionnaires with household questionnaires, with the approval of the MHLW. Household wealth is computed as the sum of household savings and household debts.

Table B.1: Descriptive Statistics of Care Sample

Variable of older adults with disabilities		Mean	Std Dev
Age and Sex (N=5,181)	Age	83.06	6.68
	Female	0.65	0.48
LTC-status (N=5,181)	Light (SL1-CL2)	0.73	0.45
	Heavy (CL3-CL5)	0.27	0.45
Marital Status(N=5,181)	Widowed	0.51	0.50
	Married	0.44	0.50
	Divorce	0.03	0.17
	Single	0.02	0.15
Children (N=5,017)	Having at least one child	0.91	0.29
Living arrangements with children (N=4,372)	Resides together	0.63	0.48
	Resides within the same municipality	0.24	0.43

Note: The data source is from the care sample of the 2016 CSLC by the MHLW. The care sample has 5,181 observations. However, the number of observations with information on children is 5,017, of which 4,372 have information on residence with children. The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

As can be seen from the table above, the average age is 83.06 years, with females comprising 65.01% of the sample. This is consistent with the findings presented in Section 2.3. The median level of care demanded is SL2. Within the sample, 72.79% have a light LTC-status, while 27.71% have a heavy LTC-status. Notably, the proportion of individuals with a light LTC-status in the care sample is greater than that in the LTC claims data, which is 65.30%.[38] This could be explained by the CSLC's focus on the non-institutionalized population, as primary public NHC services are accessible solely to older adults with a heavy LTC-status.

When looking at the family structure, widowed and married individuals comprise approximately 94.66% of the sample. When narrowing the focus to those providing information about children, 4,562 individuals (90.39%) have at least one child out of 5,017. Additionally, among the 4,372 individuals who have at least one child and provide information on living arrangements with their children, 3,787 (86.62%) have at least one child who lives together or resides in the same municipality.

Living Arrangements with Children The trend of living arrangements with children persists. In the 2016 CSLC, approximately 79.76% of disabled older adults having children live with at least one child or reside in the same municipality. Additionally, confirming the trend from 1992 to 2019, the average proportion of older adults with at least one child living together or in the same municipality was 82.64%, gradually declining from

[38]This is calculated using publicly available tabulated data. The data are taken from the Report Survey on Situation of Long-term Care Insurance Service conducted by the MHLW in 2016.

86.89% in 1992 to 78.37% in 2019. Furthermore, the breakdown illustrates a reduction in the proportion of cohabiting individuals, decreasing from 66.65% in 1992 to 53.07% in 2019, while the proportion of children residing separately in the same municipality has increased from 20.24% in 1992 to 25.30% in 2019.

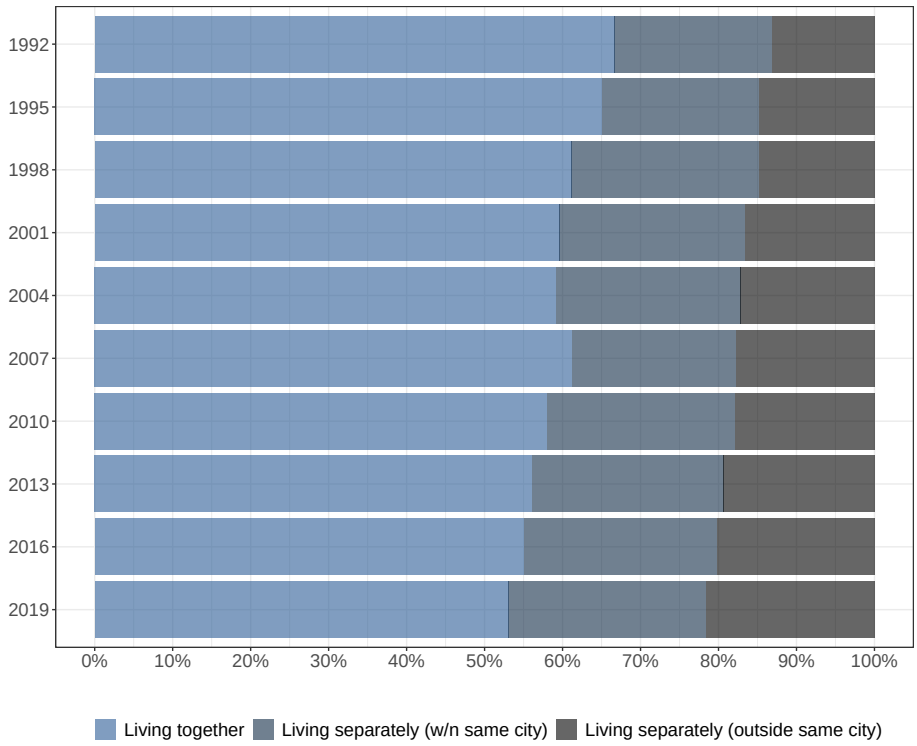


Figure B.1: Time Trends of Living Arrangements with Children

Note: The data source is from the CSLC by the MHLW. The sample is contracted from large-scale surveys from 1992 to 2019 by matching household questionnaires with long-term care questionnaires and comprising individuals who have at least one child, aged between 65 and 94 years, and with information on living arrangements with their children. The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

Family Sample The family sample is constructed by narrowing down the care sample to those who are widowed or married, with at least one child residing with them or in the same municipality. Figure B.2 shows the distribution of the family sample by five-year age groups, sex, and marital status.

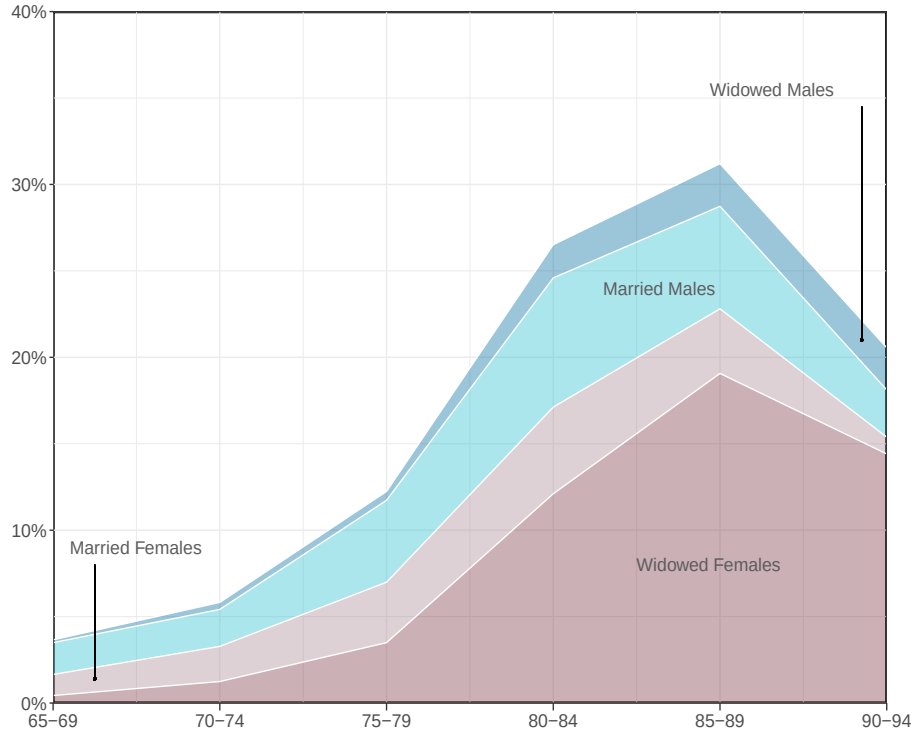


Figure B.2: Distribution of Family Sample by Five-year Age-group, Marital status, and Sex

Note: The data are from the CSLC by MHLW in 2016. The CSLC sample is constructed by matching household questionnaires with long-term care questionnaires, including those who are eligible for LTCI (65-94 years old) and those who are widowed or married with at least one child living together or in the same city. Moreover, we limit the CSLC sample to observations with information on the care level, primary, and other caregivers (3,692 observations). The numbers in the table are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

As shown in Figure B.2, until their late-70s, married males account for the largest share of the age group. However, after the late-70s, the proportion of widowed females increases sharply and exceeds that of married males. This is consistent with the empirical facts in Section 2.3 that the eligibility rate is slightly higher for males until the mid-70s but reverses later, and males have higher mortality rates than females for all ages and LTC-statuses. Moreover, the number of observations in the family sample increases with age until the early-90s. This is consistent with the empirical facts in Section 2.3 that the disability risks increase with age. The fewer number of observations in the 90–94 age group could be explained by the increase in mortality risks with age.

Table B.2 shows the distribution and characteristics of primary caregivers by family structure. As can be seen from widowed older adults, more than 80% receive care primarily from their children, including both their own children and children-in-law. The demographic characteristics of caregiving children exhibit similarities between widowed females and males. The average age of their children (primary caregivers) ranges from the mid to late 50s for both their own children and children-in-law. While slightly over

half of their own children are females, more than 95% of children-in-law are females. Regarding employment, their own children are more likely to be regular workers, while their children-in-law tend to be contingent workers.

When looking at married older adults, the primary caregivers are their own spouses. When comparing married males and married females, the latter are more likely to be cared for by their own children and children-in-law. The characteristics of their spouses (primary caregivers) show their average age in the late 70s and very low labor participation rate (about 10%). This suggests that care is primarily provided by individuals who have retired from the labor market.

Table B.2: Characteristics of Primary Caregivers by Marital Status and Sex

	Primary Caregivers				
	IC (own child)	IC (child-in-law)	IC (spouse)	IC (other)	FHC
Widowed Females					
Distr. of primary caregivers	63.11%	25.29%	0.00%	1.88%	9.71%
Age	58.77	58.46	-	33.01	-
Female	55.14%	98.73%	-	48.10%	-
LFP	59.19%	58.44%	-	59.52%	-
% Regular	43.94%	22.14%	-	87.64%	-
% Contingent	32.52%	43.28%	-	6.13%	-
% Self Employment	16.40%	5.14%	-	6.24%	-
Married Males					
Distr. of primary caregivers	21.20%	4.94%	68.09%	0.73%	5.05%
Age	53.77	55.88	76.07	31.28	-
Female	57.59%	98.39%	100.00%	56.31%	-
LFP	72.01%	65.55%	11.86%	36.77%	-
% Regular	39.56%	31.83%	19.12%	100.00%	-
% Contingent	33.30%	49.85%	19.57%	0.00%	-
% Self Employment	12.48%	2.31%	32.34%	0.00%	-
Married Females (N=606)					
Distr. of primary caregivers	29.52%	10.42%	52.70%	0.46%	6.90%
Age	54.68	55.64	79.32	76.00	-
Female	60.40%	94.30%	0.00%	100.00%	-
LFP	66.04%	59.71%	15.83%	0.00%	-
% Regular	31.22%	36.75%	23.30%	-	-
% Contingent	47.47%	37.47%	13.42%	-	-
% Self Employment	16.20%	6.61%	56.25%	-	-
Widowed Males (N=292)					
Distr. of primary caregivers	59.78%	21.61%	0.00%	2.08%	16.53%
Age	55.36	54.00	-	26.00	-
Female	52.48%	96.99%	-	84.28%	-
LFP	71.18%	50.55%	-	82.48%	-
% Regular	50.19%	38.77%	-	100.00%	-
% Contingent	24.67%	40.18%	-	0.00%	-
% Self Employment	22.83%	1.70%	-	0.00%	-

Note: The data source is from the care sample of the 2016 CSLC by the MHLW. The CSLC sample is constructed by matching household questionnaires with long-term care questionnaires, including those who are eligible for LTCI (65-94 years old) and those who are widowed or married with at least one child living together or in the same city. The sample is limited to observations with information on the level of care, primary caregivers, other caregivers, and the use of FHC services (1,865, 915, 606, and 292 observations for widowed females, married males, married females, and widowed males, respectively). The figures are derived from the author's calculation and may not correspond to the numbers published by the MHLW.

C More Details on the Structural Model

C.1 Models of Value Function

Light LTC-status in Public Nursing homes The state variables of families are given as $(j^k, a, z, z', h = 2, \iota_{-1} = 1, \mu)$. The value function is expressed as follows.

$$V_{j^k}^{LI}(a, z, z', h = 2, \iota_{-1} = 0, \mu) = \max_{c_k, l_{kf}, a'} \left\{ u_k(c_k, l_{kf}) + u_p(\bar{c}) + \beta \, \mathbb{E} \, \tilde{V}_{j^k+1}(\mathbf{x}') \right\}$$

subject to

$$(1 + \tau^c)(c_k + \bar{c}) + a' + H_{pf}^{oop} = Ra + (1 - \tau^l)(1 + \nu)(y_{kf} + y_{km}) + \text{pen}_{pf} - M_{pf}^{oop} + tr$$
$$a' \geq 0$$

$$\mathbb{E} \, \tilde{V}_{j^k+1}(\mathbf{x}') = \begin{cases} \sum_{\mu'} \Lambda(\mu', \mu)[\Psi(h' = 2 \mid h = 2, j^p) V_{j^k+1}^{LI}(a', z, z', h' = 2, \iota_{-1} = 1, \mu') & \text{if } j^k < J \\ \qquad + \Psi(h' = 3 \mid h = 2, j^p) V_{j^k+1}^{HI}(a', z, z', h' = 3, \iota_{-1} = 1, \mu') \\ \qquad + \Psi(h' = 4 \mid h = 2, j^p) V_{j^k+1}^{K}(a', z, z', h' = 4, \mu')] \\ \\ (1 + \nu) \sum_{z''} \Omega_{z''|z'} \sum_{\mu'} \overline{\Lambda}(\mu') V_1^{ND} \left(\frac{a'}{(1+\nu)}, z', z'', h' = 1, \iota_{-1} = 0, \mu' \right) & \text{if } j^k = J \end{cases}$$

Light LTC-status at Home The state variables of families are given as $(j^k, a, z, z', h = 2, \iota_{-1} = 0, \mu)$. The value function is expressed as follows.

$$V_{j^k}^{LC}(a, z, z', h = 2, \iota_{-1} = 0, \mu) = \max_{\phi \in \{0, 1/8, 1/2, 1\}} \left\{ \max_{c_k, c_p, l_{kf}, a'} \{ u_k(c_k, l_{kf}) + u_p(c_p, \phi) + \beta \, \mathbb{E} \, \tilde{V}_{j^k+1}(\mathbf{x}') \} \right\}$$

subject to

$$(1 + \tau^c)(c_k + c_p) + a' + H_{pf}^{oop} = Ra + (1 - \tau^l)(1 + \nu)(y_{kf} + y_{km}) + \text{pen}_{pf} - M_{pf}^{oop} + tr$$
$$a' \geq 0$$

$$\mathbb{E} \, \tilde{V}_{j^k+1} = \begin{cases} \sum_{\mu'} \Lambda(\mu', \mu)[\Psi(h' = 2 \mid h = 2, j^p) V_{j^k+1}^{LC}(a', z, z', h' = 2, \iota_{-1} = 0, \mu') & \text{if } j^k < J \\ \qquad + \Psi(h' = 3 \mid h = 2, j^p) V_{j^k+1}^{HC}(a', z, z', h' = 3, \iota_{-1} = 0, \mu') \\ \qquad + \Psi(h' = 4 \mid h = 2, j^p) V_{j^k+1}^{K}(a', z, z', h' = 4, \mu')] \\ \\ (1 + \nu) \sum_{z''} \Omega_{z''|z'} \sum_{\mu'} \overline{\Lambda}(\mu') V_1^{ND} \left(\frac{a'}{(1+\nu)}, z', z'', h' = 1, \iota_{-1} = 0, \mu' \right) & \text{if } j^k = J \end{cases}$$

C.2 Models of Caregiving

Previous empirical studies show a positive correlation between parental transfers (e.g., bequests and inter-vivos transfers) and child-provided IC. For example, in Japan, children who provide IC to their parents are more likely to receive a larger share of bequests than other children (Horioka 2002), and children who expect to receive bequests from their parents tend to live with them and have more contact with them (Yamada 2006). Various theoretical models have been discussed to explain these empirical facts. We discuss two main theoretical models: (i) two-sided altruism and (ii) strategic bequest motives.

In two-sided altruism, parents and children exhibit altruism toward each other (Laitner 1997; Laferrère and Wolff 2006). The parental transfers of resources to children become altruistic behaviors to compensate for the loss of utility from the burden of child-provided IC. Additionally, altruistic children voluntarily provide IC. Models with two-sided altruism have dynastic structures: children inherit their family line and resources from their parents. In contrast, for strategic bequest motives, parents provide transfers to receive IC from children (Bernheim et al. 1985; Cox 1987). When children do not voluntarily care for their parents as much as they would like, parents can transfer their resources to their children contingent on IC.

However, there is no consensus on which theoretical model is most accurate. As discussed in Groneck (2017), it remains challenging to identify the motives underlying the substantial impact of caregiving on bequests because both theoretical models can account for the positive correlation between parental transfers and child-provided IC. Kopczuk and Lupton (2007) show significant heterogeneity in bequest motives.

Previous Literature Both approaches have been used in previous structural models of caregiving. The two-sided altruism model is tractable compared to the model with strategic motives and can capture child-provided IC in low-wealth families. However, two-sided altruism makes it difficult to analyze the timing of parental inter-vivos transfers and the different wealth accumulation paths of parents and children. Estimating the strategic bequest motives requires detailed data on the existence of inter-vivos transfers and the savings paths of children and parents. For example, Barczyk and Kredler (2018) and Barczyk et al. (2023) consider both two-sided altruism and the bargaining process between parents and children by developing a dynamic non-cooperative framework. As parents in the U.S. tend to divide their bequests equally and allocate inter-vivos transfers and written wills for unequal transfers, Mommaerts (2025) considers a cooperative framework with limited commitments and Ko (2022) uses a non-cooperative decision-making between parents and children. In contrast, Bueren (2023) uses bequest motives as a warm glow using U.S. data. İmrohoroğlu and Zhao (2018) use two-sided altruism by focusing on within-family saving behavior using data in China.

This Paper This study uses the two-sided altruism framework because empirical facts suggest that bequest motives and child-provided IC are consistent with two-sided altruism.

First, as shown in Figure 2, even in families with low wealth, children are the primary caregivers in nearly 80% of cases. If children have strategic bequest motives, children in extremely poor families have no incentive to provide care for their parents.

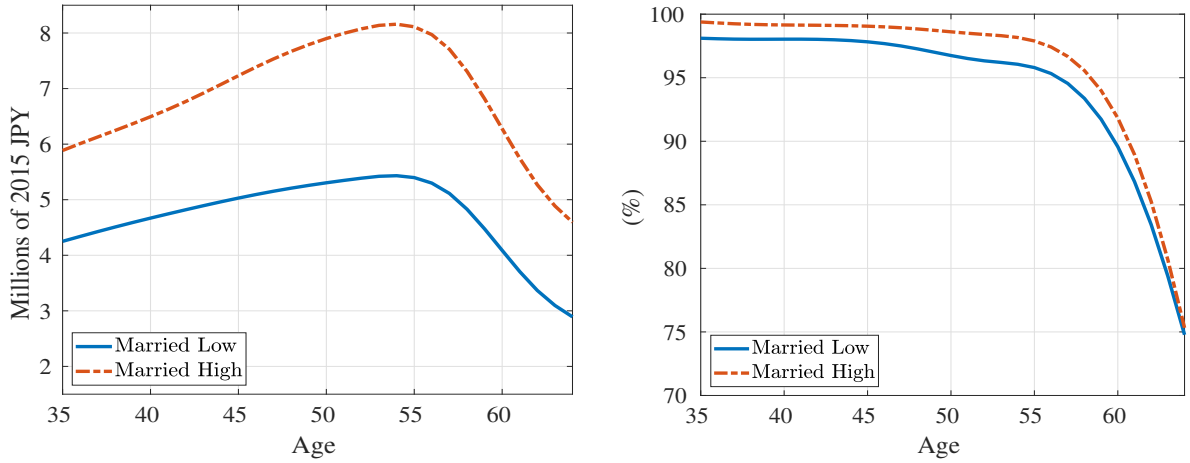
Second, empirical literature suggests that bequest motives and child-provided IC are consistent with two-sided altruism. Hamaaki et al. (2019) show that bequest motives and children's help in LTC are consistent with dynastic motives, by comparing bequest distribution patterns when the first parent dies (primary inheritance) and when the second parent dies later (secondary inheritance). In particular, the fact of secondary inheritance suggests the existence of strong traditional family norms. Japanese parents divide their bequests unequally among their children and do not leave inter-vivos transfers or written wills.

Although this study considers two-sided altruism, further research on bequest motives and caregiving is desirable. Identifying these causal relationships is crucial for analyzing the saving behavior of older adults.

D More Details of Calibration

D.1 Endowments for Married Males

This study calculates the average earnings of married males (Figure 4) by multiplying the earnings and labor force participation of married males, using ESS data for 2017, and adjusting them to 2015 levels with the CPI. Figure D.1a and D.1b show the life-cycle profiles of earnings and labor force participation for the working-age married males by age and skill.



(a) Earnings

(b) Participation Rates

Figure D.1: Earnings and Participation Rates of Married Males by Age and Skill

Note: Figure D.1 reveals earnings and labor force participation of married males by age and skill. The married sample includes both widowed and divorced individuals. We define individuals as high-skilled if they have a college or higher degree and as low-skilled otherwise. The data are obtained from the Employment Status Survey (ESS) of the Ministry of Internal Affairs and Communications (MIC) in 2017. We use the data from 2017 and adjust them to the 2015 level using the consumer price index.

E Computation Algorithm

In this section, we present the algorithms used to compute the steady state following the five steps described below.

Step 1 Guess $\text{pen}_{pf}(j^p, z)$ and τ^{ls}.

Step 2 Given the interest rate r and a set of government policies $\{\lambda^h, \lambda^m, \tau^c, \tau^a, \tau^l\}$, calculate the problem of the family. Guess then the value function of no-disability of age $j^k = 1$, $V^{ND}_{j^k=1}$, and solve the family problem by backward induction. Update the guess of $V^{ND}_{j^k=1}$ and iterate until convergence.

Step 3 Compute the set of age-dependent measures of the family $\{X\}^J_{j^k=1}$ from the policy function in Step 2. Guess the age-dependent measures of age $j^k = 1$, X_1, and calculate the age-dependent measures to satisfy equations (5) and (6). Update the guess of X_1 and iterate until convergence.

Step 4 Use the policy function and set of age-dependent measures of family and calculate aggregate variables.

Step 5 Use equation (3) and government budget conditions to update the guesses of $\text{pen}_{pf}(j^p, z)$ and τ^{ls}, if needed.