A Welfare Analysis of Long-Term Care Insurance in Japan *

Minamo Mikoshiba†

September 28, 2022

Abstract

This study examines how long-term care (LTC) risks affect an individual's life cycle behavior and analyzes the roles of the long-term care insurance (LTCI) system in Japan, which houses the oldest population in the world and, therefore, has a public universal LTCI system. We build a structural overlapping generations model with two-sided altruism introducing two-stage family care arrangements between an older parent and adult children. This study quantifies the economic and welfare effects of the insurance system and evaluates the Japanese universal LTCI system with a benefits-in-kind, compared to alternative LTC policies. We find that universal LTCI protects households well against LTC risks in old age. Owing to a significant burden of care and in the absence of a universal LTCI system, households turn to informal care or a welfare programs. The welfare effects are strictly negative even if the government provides a lump-sum subsidy to each household. Further, we demonstrate that LTCI with a benefits-in-kind policy is more expensive than LTC with cash benefits, even though LTCI with a benefits-in-kind policy positively impacts caregivers' labor supply. However, the welfare effects of LTCI with cash benefits depend on the cash benefits' generosity.

Keywords: Social security, Long-term care, Long-term care insurance, Overlapping generations model, Japan.
JEL Classification: D15, E6, E14, I10, I13

*We thank Kozo Ueda, Naoki Takayama, Nirei Makoto, Noguchi Haruko, Ryo Jinnai, Sagiri Kitao, So Kubota, Yuta Takahashi, and participates of the seminar at Waseda University and Hitotsubasi University for helpful comments. This study was financially supported by the Japan Society for the Promotion of Science (JSPS KAKENHI Grant Number 20J20006). The Ministry of Health, Labour and Welfare (MHLW) approved the use of the Comprehensive Survey of Living Condition under Tohatsu-1130-2 as of November 30, 2020. The MHLW also approved the use of the Statistics of Long-term Care Benefit Expenditures under Tohatsu-0507-3 as of May 7, 2018.

†University of Tokyo, Email: minamo.mikoshiba@gmail.com.

1 Introduction

Japan has been experiencing unprecedented demographic aging, along with an increase in life expectancy. This ongoing demographic aging has increased the risk of long-term care (LTC) and expanded the demand for LTC services. A minimum of 18.4% of people over 65 years of age need LTC. Due to the increase in the risk of age-related diseases, such as dementia, approximately 60% of people over 85 years of age need LTC—according to the 2019 Report Survey on Situation of Long-term Care Insurance Service of the Ministry of Health, Labour and Welfare. The increasing proportion of late-stage older people has obligated the Japanese government to anticipate a further increase in the burden on households and, thus, to publicity fund social security. The growing number of older people citizens has imposed immense pressure on the government to find ways to deal with their caregiving needs.

In this context, this study establishes the following two objectives: The first objective is analyzing how the LTC risk affects an individual's life cycle behavior. Since an accurate assessment of LTC risk is critical to the analysis, we use nationwide administrative claims data to capture the process of LTC shocks over the life cycle. Once the LTC risk hits, older people and their families face a trade-off between unpaid family care (informal care, hereinafter, IC) and care services provided by the market, such as community-based formal home care services (FHC) and nursing home care services (NH).[1] The former imposes a significant time burden on households and, thereby, disrupts caregivers' labor supply. The latter imposes significant financial burdens on caregivers. Hence, we carefully examine family care arrangements among three types of care options—IC, FHC, and NH—using nationally representative micro survey data.

The second objective is quantifying the welfare cost of the long-term care insurance (LTCI) system, relative to alternative policies, in order to evaluate the role of the LTCI system. Specifically, we investigate LTCI's effects on heterogenous households, and focuses on the role of a universal LTCI system with a benefits-in-kind policy. The Japanese LTCI system covers all citizens and provides them with an identical set of benefits-in-kind. The Japanese LTCI system offers only services, unlike Germany and South Korea, which have universal LTCI for older people wherein cash transfers are available.

First, we document two empirical facts regarding the LTC risk and family care arrangements. For LTC risk in old age, we use nationwide administrative claims panel data constructed by Mikoshiba et al. (2022). This panel data cover every LTCI-eligible Japanese citizen. Further, these data contain information about the LTC status of individuals objectively assessed based on their physical and cognitive conditions. Using the

[1] Community-based FHC services include housekeeping, bathing, visiting nurses, rehabilitation, day services, short-stay services, medical care management counseling, welfare device leasing/purchasing, and home renovation. By contrast, NH, as well as chronic-care hospitals, are included in institutional services.

panel data, we find that LTC risk and severity increase nearly monotonically with age, especially after the mid-70s. LTC risk is highly persistent over time. Older people who need care require continuous care until death once individuals hit the LTC risk. Moreover, LTC status affects mortality risk across ages. Compared with women, men exhibit a slightly higher LTC risk until their mid-70s (which reverses thereafter) and a higher mortality ratio for all ages and LTC statuses. To the best of our knowledge, this is the first study that uses nationwide administrative data on LTC status in a rich structural model; this study exhibits a significant advantage over studies based on survey-based data (e.g., Health and Retirement Survey (HRS) in the United States) in terms of its comprehensiveness and objectivity.

Concerning the different family care arrangements, this study uses nationally representative micro-survey data—the Comprehensive Survey of Living Conditions (CSLC) by the Ministry of Health, Labour and Welfare. We find that almost 80% of older people needing care use community-based care, such as IC and FHC. Almost 70% of older people with disabilities receive both IC and community-based FHC. However, IC accounts for the majority of main caregivers, and the burden of caregiving is highly concentrated on the main caregivers. Further, we demonstrate that the family is an important caregiving source in Japan, as in the United States and European countries (Barczyk and Kredler (2019)), and that IC and FHC are substitutes rather than complements. However, a more significant number of older people receive a mix of IC and FHC in Japan. This is consistent with the Japanese LTCI system, which focuses more on community-based FHC than IC or NH. While the majority of caregiving is provided through IC, the availability of IC is highly dependent on the family structure. We find that the most common family structure comprises widowed women with their children in the same municipality. Moreover, 90% of the former are mainly cared for by their working-age children, and hence, the later face opportunity costs in the labor market. Therefore, we focus on the family care arrangements between a widowed woman and her working-age children.

To capture these facts in this study, we build an overlapping generations model with two-sided altruism. The households comprise two generations, and each generation exhibits altruistic behavior toward the other. This model is populated by heterogeneous households differing in various dimensions, including age, assets, skill, wage shocks, current LTC status, and past care choices. The adult child and older parent generation from households make decisions jointly to maximize the same objective function[2] in the sense of two-sided altruism, following Fuster et al. (2007) and İmrohoroğlu and Zhao (2018). The family chooses optimal allocations of life cycle consumption, caregiver's labor sup-

[2] Hamaaki et al. (2019) find that Japanese parents divide their bequest unequally among their children and leave neither inter-vivo transfers nor a written will. They argue that their findings are consistent with dynastic motives (two-sided altruism). Given this evidence, we use the two-sided altruism model herein.

ply, savings, and care arrangements. In order to develop a richer model of family care arrangements, this model incorporates different types of care options—IC, FHC, and NH. Subsequently, this model endogenizes family care arrangements considering the following two-stage family decisions: The family chooses between institutional care (NH) and in-home care in the first stage, and determines both the amount of IC and FHC simultaneously in the second stage. Further, this model introduces the degree of care needs because of the LTC shock process; the total care hours required depend on the level of care.

For the family, the caregiver's opportunity cost and amount of savings are crucial for making family care arrangements. The caregiver's opportunity cost significantly contributes in the labor market, given that IC involves a substantial time burden. The amount of savings is also important for family care arrangements because savings are a source of insurance against LTC risks in old age. Once an older parent hits LTC shocks, the household must draw on their savings because of the large expenditure incurred for formal care services. When the household has sufficient savings, households face a trade-off between a reduction in current labor income because of using IC and a smaller bequest from a savings cutoff to purchase formal care services. By contrast, when households lack the savings required to purchase formal care services, they turn to either IC or a welfare program.

We calibrate the model parameters to 2015's Japanese economy with LTCI. Relative to the pattern of care arrangements within the community in the data, the model replicates the overall pattern of care arrangements well. This study evaluates the universal insurance system with a benefits-in-kind policy by quantifying the welfare cost and LTCI burden relative to alternative LTC policies.

We find that universal LTCI protects households well against LTC risk in old age. When the government eliminates the LTCI system, the cost of formal care services increases, and households cope with the burden of care by providing greater IC. LTC risks may induce precautionary savings. However, in poorer households, the massive burden of care would deplete their savings and they would then need to turn to the welfare program. In this case, reductions in government expenditure from eliminating LTCI may be offset by higher expenditures on the welfare program. Hence, even when a lump-sum tax is adjusted to balance the government budget, the welfare effects remain strictly negative because the compensation falls short in covering the significant LTC burdens.

Further, we consider the roles of LTCI with a benefits-in-kind policy by simulating the alternative scenario wherein the LTCI system provides only cash transfers. When the government provides sufficient cash transfers to purchase the average amount of FHC services in the baseline model, the ratio of IC in total hours rises and, correspondingly, caregivers' labor force participation and households' average savings fall. Although the cost of formal care exceeds the cost of providing IC, the cash transfers compensate for the reduction in the labor income of caregivers, who are middle-aged married women. Hence, the compensation increases welfare effects for all combinations of skill types. Moreover, when a tax is adjusted to balance the government budget, the government imposes a lump-sum tax on each household because of the reduction in the tax revenues from the labor income of middle-aged married women and capital income. However, a lump-sum tax's impact is modest because the labor income of middle-aged married women is significantly lower than that of men. Therefore, LTCI with cash transfers—instead of a benefits-in-kind policy—still results in positive welfare effects, but the welfare effects are smaller than those from no tax adjustment.

Our study builds on multiple lines of literature. This study is related to a huge body of literature investigating the roles of government insurance policies for older people.[3] In particular, this study contributes to the recent growing literature investigating the roles of LTC policies. Barczyk and Kredler (2017) focus on means-tested Medicaid and evaluate the non-means-tested IC and formal care subsidies as alternative scenarios. They show that the combination of IC and formal care subsidies precipitates a large welfare gain, a reduction in fiscal spending on Medicaid, and a decline in labor income tax revenues. This is because low-income earners respond to IC subsidies, and a decline in their labor income tax revenues modestly impact total tax revenues. In another stream of literature, Brown and Finkelstein (2008), Mommaerts (2015), Ko (2022), and Braun et al. (2019) discuss the demand for Medicaid and the private LTCI market in the United States. Koreshkova and Lee (2020) study interactions of Medicaid and the NH market. Our study contributes to this literature by evaluating the LTC policies, such as universal LTCI with a benefits-in-kind policy, by considering means-tested welfare programs and cash transfers.

This study is also related to the literature on the effect of LTC risk on households' life cycle behavior. The macroeconomics literature on old age risk highlights the existence of precautionary saving against LTC risks in old age. Kopecky and Koreshkova (2014), Ameriks et al. (2020), and Bueren (2022) show that the impending risk of future LTC spending induces older parents to hold on to assets for self-insurance. De Nardi et al. (2010) find that medical expenditures in later life are important in explaining the slow spending down of wealth in retirement. Lockwood (2018) shows that precautionary savings against LTC risk precipitate large bequests when individuals do not need LTC.

[3] A large macroeconomic literature has analyzed the role of public pension systems. Auerbach et al. (1987) is an earlier work, which shows that the public pension system reduces incentives for individuals to save and work, and these distortions generate welfare loss. Fuster et al. (2007) reveal consistent results under a dynastic framework wherein households have family insurance. Moreover, recent studies have focused on insurance policies' roles in health and medical expenditures risks. In earlier studies, Attanasio et al. (2010) consider the roles of Medicare, Braun et al. (2017) study the optimal size of means-tested Medicaid, and Pashchenko (2013) evaluate the implications of the Affordable Care Act. Fukai et al. (2021) show that the welfare effects of universal health insurance reform depend on household income levels and the generosity of the welfare program.

İmrohoroğlu and Zhao (2018) introduce a dynastic framework and show that households cope with LTC risk by increasing savings when the family insurance channel weakens.[4] We use the dynastic framework in this model; herein, we incorporate different types of care options, including IC by family members.

This study is also related to the empirical applied microeconomic literature in terms of family care arrangements. Various studies have revealed that IC negatively impacts caregivers' labor force participation. Van Houtven et al. (2013) and Skira (2015) find that caregivers in the United States are less likely to work than non-caregivers. Additionally, Sugawara and Nakamura (2014) reveal the negative impact using Japanese data.[5] Fu et al. (2017) reveal that Japanese LTCI with benefits-in-kind exerts significant and positive spillover effects on caregivers' labor force participation. By contrast, Geyer and Korfhage (2015) demonstrate that LTCI with cash transfers negatively impacts labor force participation using German data. Moreover, several studies in Europe and the United States report that IC substitutes for formal care. Charles and Sevak (2005) provide strong evidence of substitution between IC and NH. Bonsang (2009) reveals that IC and FHC are partial substitutes.[6] Although the policy for FHC would mitigate the burden on family caregivers, we must carefully consider the substitutability or complementarity between IC and FHC to evaluate the policy.

The reminder of this study is organized as follows: Section 2 describes Japanese LTCI and our data sources, and documents empirical findings regarding LTC risks over the life cycle and family care arrangements. Section 3 presents our quantitative life cycle model. Section 4 describes the model's parametrization. Section 5 presents numerical results. Section 6 presents the concluding remarks.

2 Institutional Settings and Empirical Facts on LTC

2.1 Public LTCI System in Japan

Japan has universal LTCI, which covers all citizens and provides them with an identical set of benefits-in-kind. The insurance system was established in 2000 to support independent living for older people and to relieve family caregivers' burden.[7]

[4] Several studies have analyzed housing and LTCI. Davidoff (2010) studies the substitution relation between home equity and LTCI. Barczyk et al. (2019) investigate interactions between housing and family for the saving, spending, and inter-generational transfer behavior of older people.

[5] See also Shimizutani et al. (2008), Hanaoka and Norton (2008), Yamada and Shimizutani (2015) and Ando et al. (2021) for more studies in Japan.

[6] See also Van Houtven and Norton (2004), Bolin et al. (2008), and Mommaerts (2018) for more studies.

[7] See Tamiya et al. (2011) and Campbell and Ikegami (2000) for further details on the LTCI system in Japan, including its history.

All individuals aged 40 years and above are enrolled in this program and pay premiums. Everyone aged 65 years and older is eligible for benefits.[8] Owing to the universal LTCI coverage, eligible individuals receive benefits irrespective of income or family status. Eligibility for LTCI is assessed using a 74-item questionnaire based on Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL). Eligibility is categorized into one of seven care levels by a computer algorithm and an expert committee.[9] The seven LTC-need levels are SL1, SL2, CL1, CL2, CL3, CL4, and CL5, with SL1 and CL5 representing the mildest and most severe needs, respectively. SL refers to recipients living independently but requiring help for IADL, and SL1-2 represents recipients eligible for preventive LTC services. CL refers to recipients requiring greater help for IADL and ADL than SL recipients, and CL1-5 represent those eligible for LTC services.

Japanese LTCI provides only services, and no cash allowance. Eligible individuals can choose their LTC services and suppliers from the LTC market. Both community-based FHC and NH services are covered under these LTC services. Japanese LTCI establishes the ceiling amount for services that can be purchased as benefits for each level of LTC needs.[10] As long as the services are within the ceiling amount, eligible recipients can use the services with a copayment ratio of 10%. The copayment ratio is the same for different types of LTC services. However, when using an NH service, recipients are required to pay living costs, which LTCI does not cover.

The Japanese LTCI system is designed to emphasize community-based care over institutional care owing to a growing need for LTC and concern regarding the fiscal burden. For example, the main public NH services (i.e., *tokubetsu-yogo-roujin-shisetsu*) are only available to older people with disabilities from CL3–CL5—except when the LTC-need level improves after entering the NH or family circumstances deteriorate.

2.2 Data Description

We use two data sources to capture family care arrangements for the patterns of LTC risk in old age and older people with disabilities. These sources are the Statistics of Long-term Care Benefit Expenditures (hereinafter, SLBE) and the Comprehensive Survey of Living Conditions (CSLC), provided by the Ministry of Health, Labour and Welfare.

[8]Individuals between 40 and 64 years are eligible for benefits only if they need LTC because of aging-related diseases.

[9]Reassessments are conducted every year in principle. For those who are certified for the first time, reassessments are performed six months following the first certification. Individuals can request a re-assessment if they experience a decline in health or if they have questions about the assessment's results. See Tsutsui and Muramatsu (2005) for further details on the certification process.

[10]The ratio of recipients exceeding the ceiling amount of benefits is extremely low—1.3% of all the recipients in 2015—according to the Ministry of Health, Labour and Welfare.
https://www.mhlw.go.jp/file/06-Seisakujouhou-12300000-Roukenkyoku/201602kaigohokenntoha_2.pdf (in Japanese, page 22)

The SLBE refers to the nationwide LTC claims data comprising LTCI claims. It covers every Japanese citizen who is eligible for LTCI. The SLBE contains information about all LTCI recipients, including information on gender, age, levels of care need, service use, and expenditures for each LTC service.[11] This study uses the panel data of LTC status of recipients aged 65–94 years, constructed by Mikoshiba et al. (2022) for the 2007–2018 period. The average number of observations from 2007–2018 is about 2.76 million individuals for each year. The panel data include 812,910 unique observations of individuals born between 1912 and 1951. Section 2.3 documents the LTC risk in old age.

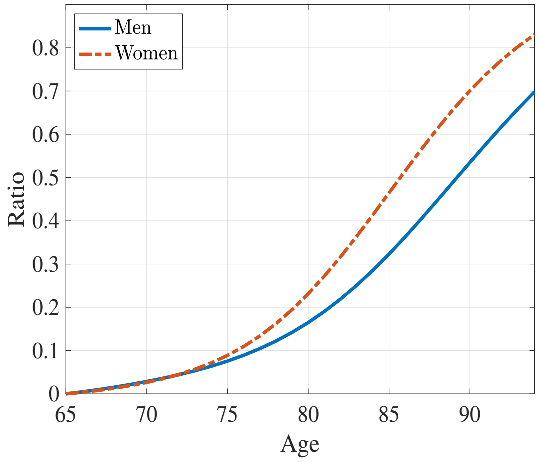
The CSLC is a nationally representative repeated cross-section micro survey of the non-institutionalized population—first conducted in 1986. The CSLC obtains basic data on living conditions and provides multi-dimensional information on community-dwelling people with disabilities. It includes four questionnaires focusing on households, health, income and saving, and LTC. While the CSLC is conducted annually, a large-scale survey including information regarding LTC is conducted once every three years. For our research purposes, we use a large-scale survey in 2016 and questionnaires related to households and LTC. The 2016 household questionnaires cover approximately 710,000 persons, randomly sampled in 5,410 districts from the 2010 National Census. The 2016 LTC questionnaires complementarily cover approximately 8,000 LTCI-certified individuals from 2,446 of the aforementioned 5,410 districts.[12] We construct a sample including all eligible LTCI recipients between 65 and 94 years of age by combining the data from questionnaires on households and LTC (hereinafter the *care sample*). This sample comprises 5,248 individuals. Section 2.4 describes the empirical facts pertaining to family care arrangements.

2.3 Empirical Facts: LTC risk in old age

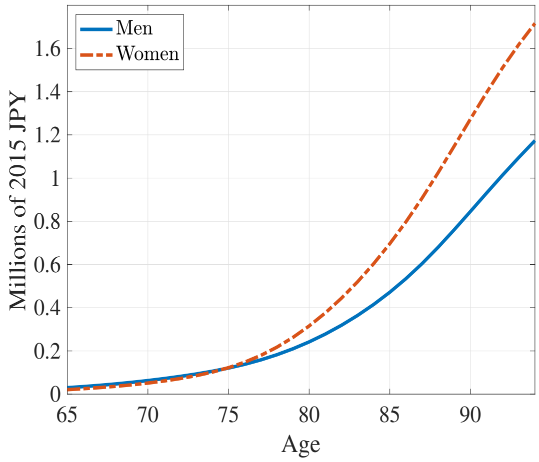
This section documents the LTC risk in old age to capture the LTC risk process. First, Figure 1 presents the average ratio of eligible LTCI recipients and life cycle profile of the average annual gross LTC expenditures per capita by age and gender. Figure 1a presents the average ratio of eligible LTCI recipients from 2007–2018, which increases nearly monotonically with age. The ratio of eligible LTC recipients is relatively low and remains less than 10% for both genders until their mid-70s. However, the ratio grows sharply from their mid-70s and reaches 69.81% and 83.02% at 94 years for men and women, respectively. At the same time, until their mid-70s, the ratio of eligible LTC recipients is slighter higher for men but subsequently reverses. Regarding the increase in LTC risk, the average annual gross LTC expenditures per capita start rising sharply when recipients reach their mid-70s, as shown in Figure 1b.

[11]Further detailed information can be found here: https://www.mhlw.go.jp/english/database/db-hss/soltcbe.html

[12]Further detailed information can be found here: https://www.mhlw.go.jp/english/database/db-hss/cslc.html



(a) Ratio of eligible LTCI recipients



(b) Annual LTC expenditures per capita

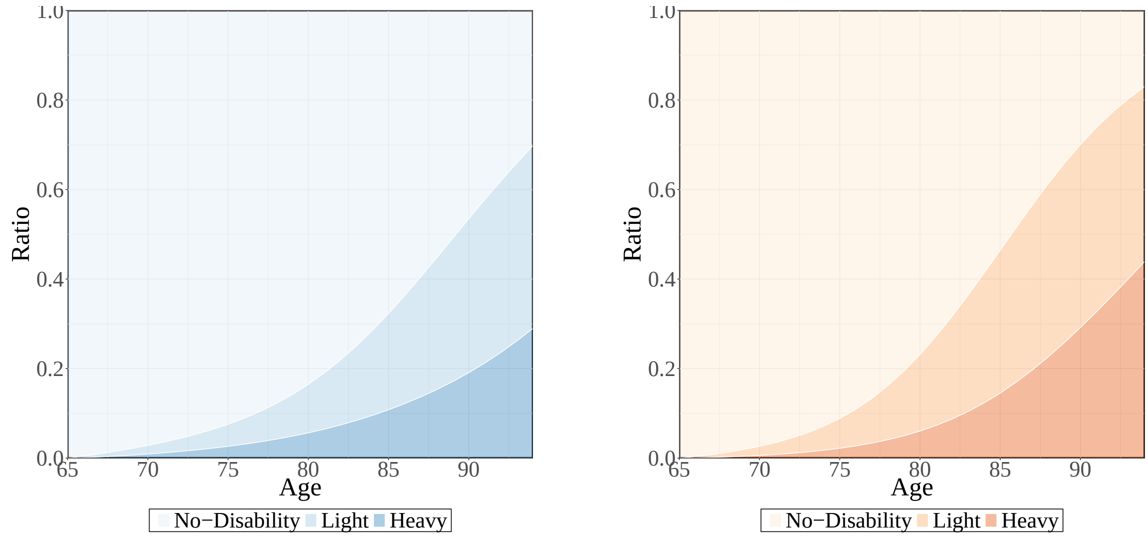
Figure 1: Ratio of eligible LTCI recipients and Annual LTC expenditures per capita

Note: Figure 1a presents the average ratio of eligible individuals for long-term care insurance in Japan by age and gender from 2007–2018. Figure 1b presents the life cycle profile of average annual gross long-term care expenditures per capita by age and gender in 2015. The data are obtained from the Statistics of Long-term Care Benefit Expenditures of the Ministry of Health, Labour and Welfare; the population data are obtained from the Population Statistics of the National Institute of Population and Social Security Research.

Despite providing suitable information regarding expected expenditures in old age, the average profiles do not provide much information regarding the heterogeneity of individuals' LTC risk. To consider the severity and persistence of LTC needs, this study classifies LTC status into four categories based on the seven LTC need levels in the LTCI system—in line with Mikoshiba et al. (2022). We call the LTC status *no-disability* if the recipient is ineligible for LTCI, *light* if eligible for LTCI and the LTC-need level ranges between the mildest support required level SL1 to care level CL2, *heavy* if eligible for LTCI and the LTC-need level ranges from CL3 to the most severe care level CL5, and *death* if deceased.

Figure 2, which presents the distribution of LTC status by age and gender, reveals that both the LTC risk and severity of LTC need increase with age. The ratio of men with heavy LTC status rises from 2.63% at 75 years to 28.97% at 94 years. Moreover, among women, the ratio of heavy LTC status increases from 2.21% at 75 years to 43.92% at 94 years.

Next, we present the high persistence of LTC status in old age. Using the same LTC status defined above, Mikoshiba et al. (2022) compute a first-order Markov process and transition matrix of LTC status by age and gender. Given the current LTC status, they compute the distribution of LTC status in the subsequent periods. Table 1 presents the transition matrices of individuals aged 80 years as an example. This table reports the distribution of their LTC status in the subsequent period when they are 81 years old,



(a) Men

(b) Women

Figure 2: Distribution of LTC status by age and gender

Note: Figure 2 presents the distribution of LTC status by age and gender. LTC status corresponds to *no-disability* if the recipient is ineligible for Japanese LTCI, *light* if eligible LTCI and the LTC-need level ranges from SL1–CL2, *heavy* if eligible for LTCI and the LTC-need level ranges from CL3–CL5. The data are obtained from Mikoshiba et al. (2022), who use the Statistics of Long-term Care Benefit Expenditures of the Ministry of Health, Labour and Welfare, and Japanese Mortality Database of the National Institute of Population and Social Security Research (downloaded on April 19th, 2022).

given their current LTC status.

Table 1 reveals that individuals of any current LTC status and gender will most likely remain in the same LTC status in the subsequent period. The probability of staying in the same LTC status ranges between 71.97% to 91.61% and 81.06% to 92.32% for men and women, respectively. The LTC statuses of individuals gradually worsen. If 80-year-old men are not eligible for LTCI, the transition probability is 3.72% in light LTC status, while it is 0.67% in heavy LTC status. In cases of individuals needing care, the more severe the current LTC status, the higher is the probability of transitioning to a more severe LTC status in the subsequent periods. The probability of an 80-year-old man falling under heavy LTC status in later periods is 0.67% if he has a no-disability LTC status today. However, it rises to 13.78% if he falls under light LTC status. By contrast, once individuals need LTC, the probability of transitioning to a no-disability LTC status becomes extremely low—close to zero. Mikoshiba et al. (2022) confirms these trends for all ages.

Table 1 also reveals the probability of individuals not surviving until the subsequent year by LTC status. The mortality risk for those with eligibility is higher than that for those without eligibility for LTCI.[13] Individuals with a more severe LTC-need level face

[13] Although the mortality risk of individuals with a heavy status is significantly higher than that of individuals without eligibility for LTCI for all ages, the mortality risk for those without eligibility is

Table 1: LTC Status Transition from age t to $t+1$: Samples of individual aged 80 years

	LTC status in $t+1$				
Men	No-Disability	Light	Heavy	Death	Total
No-Disability	0.9161	0.0372	0.0067	0.0400	1.000
Light	0.0001	0.7754	0.1378	0.0867	1.000
Heavy	0.0000	0.0664	0.7197	0.2139	1.000
	LTC status in $t+1$				
Women	No-disability	Light	Heavy	Death	Total
No-Disability	0.9232	0.0567	0.0053	0.0148	1.000
Light	0.0001	0.8585	0.1049	0.0365	1.000
Heavy	0.0000	0.0675	0.8106	0.1219	1.000

Note: Table 1 reports the transition matrices of individuals aged 80 years. LTC status corresponds to *no-disability* if the recipient is ineligible for Japanese LTCI, *light* if eligible LTCI and the LTC-need level ranges from SL1–CL2, and *heavy* if eligible for LTCI and the LTC-need level ranges from CL3–CL5. The data are obtained from Mikoshiba et al. (2022), who use the Statistics of Long-term Care Benefit Expenditures of the Ministry of Health, Labour and Welfare, and Japanese Mortality Database of the National Institute of Population and Social Security Research (downloaded on April 19th, 2022).

a significantly higher mortality risk across ages. For 80-year-old men, the mortality ratio for those without eligibility is only 4.00%, while it is 8.67% and 21.4% in light and heavy LTC status, respectively.

Comparing men and women, Table 1 reports that men exhibit a higher probability of death than that of women of the same age and LTC status. The mortality ratio of 80-year-old men with no-disability, light, and heavy statuses are 4.00%, 8.67%, and 21.39%, respectively. The mortality ratio of 80-year-old women with no-disability, light, and heavy statuses are 1.48%, 3.65%, and 12.19%, respectively. Mikoshiba et al. (2022) confirms these trends for all ages. Although women typically survive longer over the life cycle and the mortality rate is higher for those in need of LTC, the ratio of eligible LTCI recipients is generally higher among women—as described in Figure 2—because the mortality ratio of men requiring LTC is higher than that of women requiring LTC.

2.4 Empirical Facts: Family Care Arrangements

This section documents the family care arrangements under the Japanese LTCI system. We present the distribution of care arrangements by LTC-need level group in Table 2. We first distinguish the family care arrangements by an individual's residency—community-based care or an institution. Subsequently, we classify community residents into three types of care provision—only IC, mixed use of IC and FHC, and only FHC. Since CLSC

higher than that for light status after 90-years old. One reason for this result is that the risk of diseases such as heart disease and cancer increases with age. See Mikoshiba et al. (2022) for further details in this regard.

Table 2: Distribution of Care arrangements by LTC-need level

	Community (a)				Institution (b)
		Care arrangements within community (% of within community)			
	Total	Only IC	Mix IC-FHC	Only FHC	Total
All	81.82%	17.71%	55.20%	8.90%	18.18%
		(21.65%)	(67.47%)	(10.88%)	
LTC-need levels					
Light	95.09%	21.60%	63.26%	10.23%	4.91%
		(22.72%)	(66.53%)	(10.75%)	
Heavy	61.03%	8.84%	45.41%	6.78%	38.97%
		(14.48%)	(74.41%)	(11.11%)	

Note: Table 2 reports the distribution of care arrangements by LTC-need level in 2016. LTC-need levels correspond to *light* if eligible for LTCI, and the LTC-need level is from SL1–CL2, *heavy* if eligible for LTCI, and the LTC-need level is from CL3–CL5 in the category of Japanese LTCI. The data for (a) are obtained from the Comprehensive Survey of Living Conditions of the Ministry of Health, Labour and Welfare (MHLW). The sample is limited to individuals between the ages of 65 and 94. Each sample size within the community is 5248 for all, 3752 for light, and 1393 for heavy. The numbers in the table are derived from the author's calculation, and may not correspond to the published numbers by the MHLW. The data for (b) are obtained from the Survey by the Long-term Care Benefit Expenditures of the MHLW.

is limited to the non-institutionalized population only, we combine the CLSC with SLBE, covering both institutionalized and non-institutionalized LTCI recipients.

Table 2 reveals that a majority of the care sample lives in the community. Greater than 80% of those certified for LTCI use community-based care. The mixed use of IC and FHC is the most common care arrangement in the community, which accounts for 67.47% of the care samples. Relative to care arrangements in Europe and the United States shown in Barczyk and Kredler (2019), a more significant number of older people receive a mix of IC and FHC in Japan. This is consistent with the Japanese LTCI system, which focuses more on community-based FHC than on IC or NH.

Although only 18% of those who are certified for LTCI use NH, an increase in the LTC-need level precipitates an increase in the use of NH services from 4.91% in light LTC status to 38.97% in heavy LTC status. This increase in NH services is attributed to the institutional regulation of Japanese LTCI wherein individuals with light LTC status are ineligible to use the public NH service (i.e., *tokubetsu-yogo-roujin-shisetsu*).

To capture the burden of care and identify who provides care in the community, Table 3 documents main caregivers' annual total care hours, and the primary caregiver's care intensity. We define main caregivers as those primarily carrying the burden of care. We split the main caregivers providing IC in the community into three groups—children of those who are certified for LTCI, their spouses, and other family members. The average age of their children is 57.3 years old, most of whom are of working age. Furthermore, the average age of spouses of people with disabilities is 76.9 years old, most of whom

Table 3: Annual Care Hours and Distribution of Main Caregiver by LTC Level

	Annual Care Hour	Distribution of Main Caregiver				Hours of main caregiver (out of all hours)
		IC (Children)	IC (Spouse)	IC (Other family)	FHC	
All	1291.96	50.45%	31.06%	4.18%	14.32%	68.89%
By LTC Type						
Light	1013.09	52.49%	29.24%	4.27%	14.00%	70.00%
Heavy	2017.58	45.94%	35.44%	3.55%	15.07%	65.15%

Note: Table 3 reports the annual care hours and distribution of main caregivers by LTC-need level in 2016. LTC-need levels correspond to *light* if eligible for LTCI, and the LTC-need level ranges from SL1–CL2, and *heavy* if eligible for LTCI, and the LTC-need level ranges from CL3–CL5 in the category of Japanese LTCI. The data are obtained from the Comprehensive Survey of Living Conditions of the Ministry of Health, Labour and Welfare (MHLW). The sample is limited to individuals between the ages of 65 and 94 years. The sample sizes for annual care hours for all, light, and heavy statuses are 5,181, 3,771, and 1,410, respectively. The sample sizes for the distribution of the main caregiver for all, light, and heavy statuses are 5,248, 3,752, and 1,393, respectively. The sample sizes for hours of the main caregiver for all, light, and heavy statuses are 4,296, 3,051, and 1,211, respectively. The numbers in the table are based on the author's calculation, and may not correspond to the numbers published by the MHLW.

have retired from the labor market. We define the remaining informal caregivers, such as relatives and friends, as other family. Regarding the main caregiver's care intensity, we calculate the average ratio of care hours by primary caregivers to the total care hours.

Table 3 reveals that the total annual care hours vary significantly depending on the LTC-need level. The whole care hours in the heavy LTC status are twice as long as those in the light LTC status. People with disabilities in the light LTC status receive, on an average, 2.78 hours of total care per day, while individuals in the heavy LTC status receive, on average, 5.53 hours of care per day.

To account for who provides care in the community and the care intensity by the main caregiver, Table 3 reports the main caregiver and caregiving intensity by LTC level. For primary caregivers in the community, IC comprises the majority of the main caregivers, especially children and spouses, who account for 80% of the main caregivers. The individuals receiving FHC as the main care option account for only 14.3% of the sample. The main caregiver provides approximately 70% of the total care hours, suggesting that the burden of caregiving is heavily concentrated on the primary caregiver.

While IC represents the most preferred care option, its availability is highly dependent on the family structure. For example, IC by children is available only to recipients with children, and IC by spouses is only available for married people. Subsequently, we document the composition of the family structure, limiting it to those who are married or widowed and have children in the same municipality in the care sample (hereinafter the *family sample*).[14] We find that widowed women represent the largest group in the family

[14] When observing the composition in the care sample, married or widowed persons account for 94.6% of the total care sample, of whom 75.1% have children in the same municipality.

Table 4: Care arrangements for widowed women having children in the same city

	Care Arrangements			Distribution of Main Caregivers				Hours of main caregiver (out of all hours)
	Only IC	Mix IC-FHC	Only FHC	IC (Children)	IC (Spouse)	IC (Other family)	FHC	
All	18.89%	73.51%	7.60%	87.41%	0.00%	1.93%	10.66%	65.93%
By LTC Type								
Light	20.52%	73.69%	5.79%	89.58%	0.00%	1.88%	8.55%	66.36%
Heavy	10.63%	76.44%	12.93%	81.16%	0.00%	2.01%	16.82%	63.87%

Note: Table 4 reveals the distribution of care arrangements and main caregivers by LTC-need level in 2016. LTC-need levels correspond to *light* if eligible for LTCI, and the LTC-need level ranges from SL1–CL2, and *heavy* if eligible for LTCI, and the LTC-need level ranges from CL3–CL5 in the category of Japanese LTCI. The data are obtained from the Comprehensive Survey of Living Condition of the Ministry of Health, Labour and Welfare (MHLW). The sample is limited to individuals between the ages of 65 and 94 years. The sample sizes for distribution of care arrangements for all, light, and heavy are 2,188, 1,603, and 504, respectively. The sample sizes for distribution of the main caregiver for all, light, and heavy are 2,188, 1,603, and 504, respectively. The sample sizes for hours of care by the main caregiver for all, light, and heavy are 1,817, 1,314, and 491, respectively. The numbers in the table are based on the author's calculation and may not correspond to the numbers published by the MHLW.

sample. The primary caregivers for widowed women are their working-age children, who face opportunity costs in the labor market. Married men represent the next largest group, and their main caregivers are their wives, who have already retired from the labor market. This indicates that the care arrangements and main caregiver depend highly on the family structure. The sum ratio of widowed women and married men accounts for 75% of the family sample. The large share of these recipients can be attributed to the fact that men have LTC needs first, relative to women, and an older man typically dies before an older woman, as shown in Section 2.3.

Concerning the burden of children facing opportunity costs in the labor market, Table 4 presents the distribution of care arrangements and main caregivers of widowed women having children in the same municipality. Although the simultaneous use of IC and FHC accounts for a majority of the use regardless of the LTC need level, almost 90% of widowed women use IC from children as their primary care options. These children provide high care intensity to their widowed mothers, which is consistent with the existing literature that IC and FHC are substitutes rather than complements.

3 Model

In this section, we build an overlapping generations model with two-sided altruism. The households comprise two generations, and each generation exhibits altruism toward the other. We quantify the effects of LTC risks on individuals' life cycle consumption, female adult child's labor supply, and savings through family care arrangements. We further evaluate LTC insurance's roles. The sources of uncertainty in the model are LTC state, longevity, skills, and wage shocks. The LTC status affects the total hour requirement for care, the LTC status, and the mortality risk in the subsequent periods. This is a partial equilibrium model, and individuals take as given the paths of factor prices and various policies. Time is discrete, and the model frequency is annual.

3.1 Demographics

Individuals enter the economy at age $j = 1$, and the maximum possible age is $2J$. Individuals live as adult children during the first J periods. From $J + 1$ age, individuals become older parents: They leave the labor force and start facing LTC status shocks and longevity risk.[15]

Given this, in the model, households comprise two generations—an *adult child* generation of age $j^k \in \{1, \cdots, J\}$ and an *older parent* generation of age $j^p = j^k + J$. During the initial period of the household $j^k = 1$, the household comprises four individuals from two generations $i = \{cf, cm, pf, pm\}$, representing a female adult child, male adult child, female older parent, and male older parent, respectively.[16] The formalization of the household follows Fuster et al. (2007) and İmrohoroğlu and Zhao (2018), in the sense of two-sided altruism. In this setting, living household members make a joint decision to maximize the same objective functions. To simplify the model, this study assumes that each household member within the same generation has the same age,[17] and skill level.[18] This study does not model the marriage decision and abstracts from divorce and remarriage.

In each family, the older parent generation comprises one couple, whereas the adult child's generation comprises a measure $(1+\nu)$ couple. The annual population growth rate is v_g and $v = (1 + v_g)^J - 1$. Notably, a new generation in a family line is born only every J period, while a new generation in the economy is born in every period.

[15]This study does not consider the longevity risk of adult children since the mortality rate for those aged 35–65 years is quite low, at 0.26%, according to the Japanese Mortality Database of the National Institute of Population and Social Security Research. The details are available at http://www.ipss.go.jp/p-toukei/JMD/index-en.asp (downloaded on June 27, 2022.)

[16]The average completed number of children per married couple are stable at around 2.2 from 1970 to the early 2000s, and it drops to 1.94 in 2015, according to the Annual Population and Social Security Surveys (The National Fertility Survey) from the National Institute of Population and Social Security Research.
https://www.ipss.go.jp/ps-doukou/e/doukou15/Nfs15R_points_eng.pdf (Table II-2).

[17]The average age difference between couples from 1975–2015 is 2.4 years, according to the Vital Statistics from the Ministry of Health, Labour and Welfare.
https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/tokusyu/konin16/dl/01.pdf (in Japanese)

[18]According to Fukuda et al. (2019), who use the Census data between 1980 and 2010, Japanese married couples exhibit a high degree of sorting.

3.2 Skill

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

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

3.3 LTC Status and Mortality Risk

At the beginning of each period, older individuals face LTC and mortality risks. We denote h by an individual's LTC status. We classify LTC status h into four categories based on the LTC-need levels in the LTCI system: $h = 1$ (no-disability), $h = 2$ (light), $h = 3$ (heavy), and $h = 4$ (death).

LTC status in later periods h' depends on individuals' current LTC status h as well as age j^p. LTC status h follows a first-order Markov process with transition probabilities $\Psi(h' \mid h, j^p)$ of being LTC status h' from age j^p to $j^p + 1$. For simplicity, this study assumes that $\Psi(h' = 1 \mid h = 2, j^p) = \Psi(h' = 1 \mid h = 3, j^p) = 0$ for all j^p.[19] Death $h = 4$ is the absorbing state $\Psi(h' = 4 \mid h = 4, j^p) = 1$, for all j^p.[20]

We focus only on the LTC status of the wife in the older parent generation. Although our model focuses on the LTC status of the older wife, as in Barczyk and Kredler (2017), our model assumes that the wife's LTC status further affects the composition of the older parent generation. This assumption aims to capture quantitatively important aspects concerning an older man. The assumptions are that an older man typically dies before an older woman, he has LTC needs first compared to his wife, and in most cases, the main caregiver of the man is his wife.

The older parent generation has $n^p(j^p, h) \in [0, 2]$ members. When the older wife does not need care ($h = 1$), we assume that there are $n^p(j^p, h = 1) \in [1, 2]$ members and the older parent generation comprises one female and a male of measure $n^p(j^p, h = 1) - 1 \in [0, 1]$. The measure of the older husband $n^p(j^p, h = 1) - 1$ decreases deterministically with age j^p. The older husband also faces a deterministic LTC risk if the wife is healthy and alive. In other words, he receives not only the average gross formal care cost $H_{pm}(j^p)$ but

[19] Mikoshiba et al. (2022) presents the extremely low (i.e., close to zero) probability that an LTCI-certified individual transitions to one ineligible for LTCI.

[20] In this study, the types of LTC services used do not affect the mortality risk (refer to Applebaum et al. (1988))

also IC from his wife at a zero opportunity cost. Once the older wife needs care ($h = 2$ or $h = 3$), we assume that the older husband dies and the older wife becomes a widowed, $n^p(j^p,\ h = 2 \text{ or } h = 3) = 1$. When the older wife faces a death shock ($h = 4$), both the older wife and husband (if still alive) die, $n^p(j^p,\ h = 4) = 0$. Based on this modeling, we focus on the care arrangements between a widowed woman and her children—the most common family structure with older people in need of care—while keeping the dimensions of the state space manageable.

3.4 LTC Arrangements

When the older wife needs care ($h = 2$ or $h = 3$), the household chooses one of the following three care options—IC from her adult children, FHC, and public NH. We model the family care arrangements as two-stage decision making.

3.4.1 First Stage: Community-based Care versus Public NH

The family has to choose the older wife's residence—from either community-based care or a public NH. The family's residential choice is denoted by ι, which can be either community-based care ($\iota = 0$) or a public NH ($\iota = 1$). If the family chooses a public NH, the family incurs the cost ξ when entering the public NH. Noteworthily, as mentioned before, individuals with light LTC status ($h = 2$) are ineligible to use a public NH service (i.e., *tokubetsu-yogo-roujin-shisetsu*) under the LTCI system. Subsequently, the family's residential choice only occurs for individuals with heavy LTC status ($h = 3$).

3.4.2 Second Stage: Each residens' LTC service choices

If community-based care occurs ($\iota = 0$) at the first stage, the family has to determine both the amount of IC ϕ and FHC q at the same time to meet a minimum requirement of total care hours χ_h.

$$A\left(\theta_h(q/p_{\text{LTC}})^\rho + (1-\theta_h)(T(\phi)\times 365)^\rho\right)^{\frac{1}{\rho}} \geq \chi_h$$

where A is the return to care input hours, p_{LTC} is the price of FHC per hour,[21] ρ and θ_h represent substitutability between IC and FHC, and χ_h is the minimum requirement of the total LTC hours depending on the level of LTC needs, $\chi_{h=2} \leq \chi_{h=3}$. This formalization follows Daruich (2018) and Gao (2021). The amount of IC ϕ is a discrete choice, and the corresponding IC hours are as follows:

[21] In Japan, the fees for each LTC service are established by the national government and revised every three years. For further details regarding the fee, see, for example, https://www.mhlw.go.jp/topics/kaigo/housyu/housyu.html (in Japanese)

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

The older parent exhibits a preference for IC, ω. The more hours that IC is used, the more utility the older parent gains, as described in Section 3.6.

By contrast, once the family chooses a public NH ($\iota = 1$) at the first stage, the older wife with disabilities spends her entire life in the public NH. She is also required to pay both the LTC service cost $\bar{q}$ and the fee for public NH use $\bar{c}$, until she dies.

3.5 Endowments

Individuals work when they are adult children. A female adult child allocates her disposable time to labor supply, leisure, and informal care hours if the older wife needs care. At the beginning of each period, she faces an idiosyncratic wage shock, $\mu(j)$. The earnings of a female adult child worker are defined as follows:

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

where $\{\epsilon(j,z)\}_{j=1}^{J}$ is deterministic age-specific efficiency profiles, $\overline{WH}_{cf}(j)$ is the average working hours, $\overline{DH}_{cf}(j)$ 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 distributed normally with a mean of zero, the variance is σ_ζ^2, and $\Theta < 1$ captures the shock's persistence. We discretize this process into a three-state Markov chain using Tauchen (1986)'s method. We denote the corresponding transition matrix by $\Lambda(\mu,\mu')$. Additionally, the value of μ at birth is assumedly determined by a random draw from an initial distribution $\overline{\Lambda}(\mu)$.

We assume that the male adult child supplies labor inelasticity and its earnings are denoted by y_{cm},[22] which evolves deterministically over the life cycle and depends on the age and skill, $y_{cm}(j,z)$.

[22]The average ratio of the 35-64-years-old married men's labor force participation is 95.3% according to the 2017 Employment Status Survey of the Ministry of Internal Affairs and Communications. Subsequently, this study assumes that men invariably work in our model.

3.6 Preferences

The household utility is the sum of the adult child generation's utility u_k and older parent generation's utility u_p.

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

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

where l_{cf} denotes the leisure of a wife in the adult child generation. $\bar{l}_{cm}$ is a fixed parameter representing the exogenous leisure time of the husband in the adult child generation. $\eta(n)$ is the equivalence scale and varies with the family size. The utility of an older parent generation is

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

where c_p is the older parent generation's consumption, and leisure l_i for $i = \{pf,\ pm\}$ is the exogenous leisure time for an individual of the older parent generation. ω represents the preference parameter for IC when the older wife needs care and lives in the community.

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.

LTCI: The government provides mandatory public LTCI, as an entitlement to all, irrespective of people's income level or the availability of IC. All individuals aged 65 years and above are eligible for benefits. The out-of-pocket (OOP) expenditures paid by an individual are denoted as H_i^{op} for $i \in \{pf, pm\}$ and expressed as

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

where λ^h is the copay of the public LTC insurance. The remaining expenditures are covered by the government.

Health Insurance: Additionally, the government offers a universal health insurance program. This study assumes that medical expenditures are required when an individual is an older parent.[23] [24] The total gross medical expenditure is exogenously given, $M_i(j^p)$ for $i \in \{pf, pm\}$, depending on age and gender. The OOP expenditure is similarly defined as $M_i^{op} = \lambda_{j^p}^m M_i(j^p)$, where $\lambda_{j^p}^m$ is the co-pay of the public health insurance which depends on the age. The reminder of the OOP expenditure is covered by the government.

Public Pension: The government runs a pay-as-you-go public pension system. Individuals receive public pension benefits once they become older parents. Let $\text{pen}_i(j^p, z)$ denote the public pension benefits of individuals of age j^p, gender $i \in \{pf, pm\}$, and permanent skill z. We assume that the benefits of an older man are determined by following formula:

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

where

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

where κ is the public pension replacement rate. We further assume that the benefits of an older woman depend on the average earnings of the skill group, instead of the past individual earnings.[25]

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

Means-tested Welfare Transfer Program: Individuals with low income and wealth can be eligible for the means-tested welfare program (*seikatsu-hogo*). This covers their minimum living expenses, and the welfare program also covers their LTC expenditures. A means-tested transfer tr is provided to guarantee a minimum consumption level $\underline{c}$ for

[23]The average annual medical expenditures are relatively low, remaining close to 200,000 yen until 50 years, then subsequently increasing. However, it stays under 500,000 yen and 400,000 yen for men and women, respectively, until 65 years, according to the National Medical Expenses of the Ministry of Health, Labour and Welfare.

[24]This study assumes that no correlation exists between LTC and medical expenditures. Suzuki et al. (2012) reports no correlation between LTC and medical expenditures after controlling for inpatients and nursing home residents. This study utilizes the complete set of insurance claims data provided by the public insurers of the Fukui Prefecture in Japan; this study is written in Japanese.

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

each generation, which may differ by marital status. The transfer amount for a household is given as follows:

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

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

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 an interest rate.

The government budget constraint is given as:

$$\tau^l Y_l + \tau^a Y_a + \tau^c (C_k + C_p) + \tau^{ls} N = SS + HI + LTC + TR + G \tag{3}$$

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

In the baseline model, we assume that τ^{ls} is zero and let G absorb the imbalance and the satisfy the Equation (3) to isolate the effects of governmental LTC expenditure and focus on changes from different risks faced by households over the life cycle. In the numerical experiments in Section 5, we consider various policy scenarios and adjust τ^{ls} to account for a change in the net government revenues to balance the government budget in Equation (3).

3.8 Problems of Households

State: We summarize the state as $\mathbf{x} = \{j^k, a, z, z', h, \iota_{-1}, \mu\}$. Households are heterogenous in terms of the age of the adult child generation j^k, asset a, skill of the older parent generation z, skill of the adult child generation z', current LTC status h, previous residency ι_{-1}, and idiosyncratic wage shock for the wife in the adult child generation, μ. We define the problem of households with six value functions.

Case 1. Value Function of No Parents $(h = 4)$**:** The state vector of a household with no parents is given as $(j^k, a, z, z', h = 4, \mu)$. Given the states, a household optimally chooses consumption c_k, leisure of the wife in the adult child generation l_{cf}, and savings

a' to maximize utility over the life cycle. The value function is expressed as follows:

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

subject to

$$(1 + \tau^c)c_k + a' = Ra + (1 - \tau^l)(1 + \nu)(y_{cf} + y_{cm}) + tr$$

where

$$\begin{aligned}
&y_{cf} = \epsilon\ \mu \left(\left(\overline{DH}_{cf} - l_{cf} \right) / \overline{WH}_{cf} \right) \\
&a' \geq 0,\ \ c_k \geq 0 \\
&0 \leq\ \ l_{cf} \leq \overline{DH}_{cf}
\end{aligned}$$

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

Case 2. Value Function of Heavy-Institution ($h = 3$ **and** $\iota_{-1} = 1$)**:** The state vector of a household is given as $(j^k, a, z, z', h = 3, \iota_{-1} = 1, \mu)$. Given the states, a household optimally chooses consumption c_k, leisure of wife in the adult child generation l_{cf}, and savings a' to maximize utility over the life cycle. The value function is expressed as follows:

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

subject to

$$(1 + \tau^c)(c_k + \bar{c}) + a' + H^{op}_{pf} = Ra + (1 - \tau^l)(1 + \nu)(y_{cf} + y_{cm}) + \text{pen}_{pf} - M^{op}_{pf} + tr$$

where

$$\begin{aligned}
&y_{cf} = \epsilon\ \mu \left(\left(\overline{DH}_{cf} - l_{cf} \right) / \overline{WH}_{cf} \right) \\
&a' \geq 0,\ \ c_k \geq 0 \\
&0 \leq\ \ l_{cf} \leq \overline{DH}_{cf}
\end{aligned}$$

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

Case 3. Value Function of Heavy-Community ($h = 3$ **and** $\iota_{-1} = 0$)**:** The state vector of a household is expressed as $(j^k, a, z, z', h = 3, \iota_{-1} = 0, \mu)$. Given the states, a household optimally chooses the older wife's residence in the subsequent period ι, consumption c_k and c_p, leisure of the wife in the adult child generation l_{cf}, and savings a' to maximize utility over the life cycle. The value function is expressed as follows:

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

If the household chooses $\iota = 1$, see case 2. If it chooses $\iota = 0$, the amount of IC ϕ and FHC q become the choice variables. Notably, q is determined by minimizing the OOP expenditure for LTC when ϕ is given. thereafter, the value function can be rewritten as follows:

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

subject to

$$(1+\tau^c)(c_k + c_p) + a' + H^{op}_{pf} = Ra + (1-\tau^l)(1+\nu)(y_{cf} + y_{cm}) + \text{pen}_{pf} - M^{op}_{pf} + tr$$

where

$$\begin{aligned}
&y_{cf} = \epsilon\, \mu \left(\left(\overline{DH}_{cf} - T(\phi) - l_{cf} \right) / \overline{WH}_{cf} \right) \\
&a' \geq 0,\ \ c_k, c_p \geq 0 \\
&0 \leq\ \ l_{cf} \leq \overline{DH}_{cf} - T(\phi)
\end{aligned}$$

$$q^*(\phi) = \begin{cases} 0 & \text{if } (\chi_{h=3}/A)^\rho - (1-\theta_{h=3})(T(\phi) \times 365)^\rho \leq 0 \\ \left(\frac{(\chi_{h=3}/A)^\rho - (1-\theta_{h=3})(T(\phi)\times 365)^\rho}{\theta_{h=3}} \right)^{\frac{1}{\rho}} p_{\text{LTC}} & \text{if } (\chi_{h=3}/A)^\rho - (1-\theta_{h=3})(T(\phi) \times 365)^\rho > 0 \end{cases}$$

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

Case 4. Value Function of Light-Institution ($h = 2$ **and** $\iota_{-1} = 1$)**:** The state vector of a household is given as $(j^k, a, z, z', h = 2, \iota_{-1} = 1, \mu)$. Given the states, a household optimally chooses consumption c_k, leisure of wife in the adult child generation

l_{cf}, and savings a' to maximize utility over the life cycle. The value function is expressed as follows:

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

subject to

$$(1 + \tau^c)(c_k + \bar{c}) + a' + H^{op}_{pf} = Ra + (1 - \tau^l)(1 + \nu)(y_{cf} + y_{cm}) + \text{pen}_{pf} - M^{op}_{pf} + tr$$

where

$$\begin{aligned} &y_{cf} = \epsilon\ \mu \left(\left(\overline{DH}_{cf} - l_{cf} \right) / \overline{WH}_{cf} \right) \\ &a' \geq 0,\ c_k \geq 0 \\ &0 \leq\ l_{cf} \leq \overline{DH}_{cf} \end{aligned}$$

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

Case 5. Value Function of Light-Community ($h = 2$ **and** $\iota_{-1} = 0$)**:** The state vector of a household is given as $(j^k, a, z, z', h = 2, \iota_{-1} = 0, \mu)$. Given the states, a household optimally chooses the amount of IC ϕ and FHC hours q, consumption c_k and c_p, leisure of the wife in the adult child generation l_{cf}, and savings a' to maximize utility over the life cycle. The value function is expressed as follows:

The amount of IC ϕ and FHC q are choice variables. Notably, q is determined by minimizing the OOP expenditure for LTC when ϕ is given. Then, the value function can be expressed as follows:

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

subject to

$$(1 + \tau^c)(c_k + c_p) + a' + H^{op}_{pf} = Ra + (1 - \tau^l)(1 + \nu)(y_{cf} + y_{cm}) + \text{pen}_{pf} - M^{op}_{pf} + tr$$

where

$$\begin{aligned} &y_{cf} = \epsilon\ \mu \left(\left(\overline{DH}_{cf} - T(\phi) - l_{cf} \right) / \overline{WH}_{cf} \right) \\ &a' \geq 0,\ c_k, c_p \geq 0 \\ &0 \leq\ l_{cf} \leq \overline{DH}_{cf} - T(\phi) \end{aligned}$$

$$q^*(\phi) = \begin{cases} 0 & \text{if } (\chi_{h=2}/A)^\rho - (1-\theta_{h=2})(T(\phi)\times 365)^\rho \le 0 \\ \left(\frac{(\chi_{h=2}/A)^\rho - (1-\theta_{h=2})(T(\phi)\times 365)^\rho}{\theta_{h=2}}\right)^{\frac{1}{\rho}} p_{\text{LTC}} & \text{if } (\chi_{h=2}/A)^\rho - (1-\theta_{h=2})(T(\phi)\times 365)^\rho > 0 \end{cases}$$

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

Case 6. Value Function of No disability $(h=1)$**:** The state vector of a household is given as $(j^k, a, z, z', h=1, \iota_{-1}=0, \mu)$. Given the states, a household optimally chooses consumption c_k and c_p, leisure of wife in the adult child generation l_{cf}, and savings a' to maximize utility over the life cycle. The value function is expressed as follows:

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

subject to

$$(1+\tau^c)(c_k+c_p) + a' = Ra + (1-\tau^l)(1+\nu)(y_{cf}+y_{cm}) + \sum_{i\in\{pf,pm\}} \text{pen}_i - \sum_{i\in\{pf,pm\}} M^{op}_i - H^{op}_{pm} + tr$$

where

$$\begin{aligned} & y_{cf} = \epsilon\ \mu\left(\left(\overline{DH}_{cf} - l_{cf}\right)/\overline{WH}_{cf}\right) \\ & a' \ge 0,\ \ c_k, c_p \ge 0 \\ & 0 \le\ \ l_{cf} \le \overline{DH}_{cf} \end{aligned}$$

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

3.9 Equilibrium

Stationary recursive competitive 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 is a set of value functions $\{V^{ND}_{j^k}(\mathbf{x}),\ V^{LC}_{j^k}(\mathbf{x}),\ V^{LI}_{j^k}(\mathbf{x}),\ V^{HC}_{j^k}(\mathbf{x}),\ V^{HI}_{j^k}(\mathbf{x}),\ V^{K}_{j^k}(\mathbf{x})\}_{j^k=1}^{J}$, household's decision rules $\{c_{k,j^k}(\mathbf{x}),\ c_{p,j^k}(\mathbf{x}),\ l_{cf,j^k}(\mathbf{x}),\ a_{j^k+1}(\mathbf{x}),\ \iota_{j^k}(\mathbf{x}),\ \phi_{j^k}(\mathbf{x}),\ q_{j^k}(\mathbf{x})\}_{j^k=1}^{J}$, time-invariant measures of households $X_{j^k}(\mathbf{x})$ with age-j^k households 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.[26]

1. Given factor prices and the government policies, the household's decision rules solve the household's decision problem in Section 3.8.

2. The government's budget is balanced in Equation (3).

3. Individuals and aggregate behavior are consistent:

$$
\begin{aligned}
Y_l &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} \left[y_{cf}(\mathbf{x}) + y_{cm}(\mathbf{x})\right] X_{j^k}(\mathbf{x}) \\
&= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} \left[\frac{\epsilon(j^k, z')\mu(j^k)}{\overline{WH}_{cf}(j^k)}\left(\overline{DH}_{cf}(j^k) - \mathbb{1}_{h\in\{2,3\}}T(\phi_{j^k}) - l_{cf,j^k}(\mathbf{x})\right) + y_{cm}(j^k, z')\right] X_{j^k}(\mathbf{x}) \\
Y_a &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} Ra_{j^k}(\mathbf{x})X_{j^k}(\mathbf{x})
\end{aligned}
$$

$$
\begin{aligned}
C_k &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} c_{k,j^k}(\mathbf{x})X_{j^k}(\mathbf{x}) \\
C_p &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} c_{p,j^k}(\mathbf{x})X_{j^k}(\mathbf{x})
\end{aligned}
$$

$$
N = \sum_{j^k=1}^{J}\sum_{\mathbf{x}} \left[2 + n^p(j^p, h)\right] X_{j^k}(\mathbf{x})
$$

$$
\begin{aligned}
SS &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} \left[\mathrm{pen}_{pf}(j^p, z') + (n^p(j^p, h) - 1)pen_{pm}(j^p, z')\right] X_{j^k}(\mathbf{x}) \\
HI &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} (1 - \lambda^m(j^p))\left[M_{pf}(j^p) + (n^p(j^p, h) - 1)M_{pm}(j^p)\right] X_{j^k}(\mathbf{x}) \\
LTC &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} (1 - \lambda^h)\left[q_{j^k}(\mathbf{x}) + (n^p(j^p, h) - 1)H_{pm}(j^p)\right] X_{j^k}(\mathbf{x}) \\
TR &= \sum_{j^k=1}^{J}\sum_{\mathbf{x}} tr(\mathbf{x})X_{j^k}(\mathbf{x})
\end{aligned}
$$

[26]See Appendix A for further details of the numerical procedures.

4. The public pension benefit system is balanced in Equation (1) and (2).

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

   – For $j^k < J$,

$$X_{j^k+1}(a', z, z', h', \iota, \mu') = \frac{1}{(1+\nu)^{1/J}} \sum_{\{a,h,\iota_{-1},\mu:a',\iota\}} \Psi(h' \mid h, j^p)\Lambda(\mu', \mu)X_{j^k}(a, z, z', h, \iota_{-1}, \mu) \tag{4}$$

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

   – For $j^k = J$,

$$X_1(a', z', z'', h' = 1, \iota = 0, \mu') = (1+\nu) \sum_{\{a,z,h,\iota_{-1},\mu:a'\}} \Omega_{z''|z'}\overline{\Lambda}(\mu')X_J(a, z, z', h, \iota_{-1}, \mu) \tag{5}$$

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

3.10 Model Discussion

Before describing the model's calibration, we discuss several elements of the model, which are critical to determining the family care arrangements. We focus on the implications for the two main mechanisms in making family care arrangements—caregivers' opportunity cost and the amount of household savings.

Caregivers' opportunity cost in the labor market plays a significant role, as shown in Van Houtven et al. (2013) and Skira (2015). The opportunity cost of IC depends on wage rates and the values of leisure for family care. If the opportunity cost of adult children is relatively low, the IC cost would become cheaper than the formal care cost. In this model, permanent labor productivity and idiosyncratic labor shocks among middle-aged women determine wage rates.

Moreover, in the two-sided altruism model, the older parent's preference also affects the cost of IC provision by adult children. If the preference for IC is relatively high, the demand for IC would exceed the demand for formal care, including NH and FHC, which are covered by the LTCI system. Although the older parent's preference for IC affects the choice between IC and formal care, the older parent's preference for NH affects the care determination between NH and FHC.

The amount of savings is important for family care arrangements because savings provide a source of insurance against LTC risks in old age. Once an older parent hits LTC shocks, the family uses the savings to cover the substantial expenses of formal care services. Futhermore, the older parent's altruism also affects the decision to use savings as insurance against LTC risk in old age. The desire to leave a bequest increases the amount of savings, as shown in Lockwood (2018). In the two-sided altruism model, older parents can increase the future resources of their descendants by leaving a bequest, and adult children also can prevent the cutting-off of their older parent's bequest by providing IC, as discussed in Groneck (2017).

Subsequently, households make family care arrangements, depending on the caregiver's opportunity cost and the amount of household savings. When the household has sufficient savings, it faces a trade-off between a reduction in current labor income because of using IC, and a smaller bequest from a savings cutoff to purchase formal care services. By contrast, when households' savings are inadequate to purchase formal care services, they turn to either an IC or a welfare program.

4 Calibration

This section describes the calibration of the model's parameters. We calibrate the steady state economy to the Japanese economy in 2015. The model parameters comprise two groups. Parameters in the first group are external parameters, directly estimated from the data and literature. Table 5 summarizes their values. Parameters in the second group are internal parameters, calibrated by matching the model-generated targets' value to their data counterparts. Table 6 summarizes the description and values of the parameters. Our model is a partial equilibrium model, and the interest rate r is exogenous and set to 2%.

4.1 Demographics

We let individuals enter the economy at age $j = 1$, which corresponds to 35 years. Individuals retire from the labor market at the age of 65 years, and they live up to the maximum possible age of 94 years. We set the age difference between parents and children to 30 years because the average age difference between mother and children from 1975–2015 is 30.052 years, according to the Vital Statistics of the Ministry of Health, Labour and Welfare (MHLW). We set the annual population growth rate as zero.

The equivalence scale η adjusts consumption for the household size, which assigns $\eta(n) = 1 + 0.7(n - 1)$ for the family size n, based on Bick and Choi (2013).

4.2 LTC transition dynamics, LTC and Medical Expenditures

The LTC transition probabilities, including survival probabilities, are computed based on the SLBE data by Mikoshiba et al. (2022), which are described in Section 2.3. We assume that the number of household members in the older parent generation $n^p(j^p, h)$ depends on both the age and LTC status discussed in Section 3.3. The deterministic measure of older men $n^p(j^p, h = 1) - 1$ is calibrated based on their survival probabilities, as estimated by Mikoshiba et al. (2022).

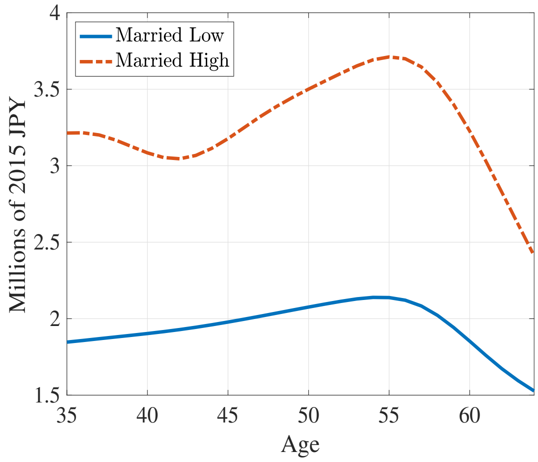


Figure 3: Earnings of Married Women by Age and Skill

Note: Figure 3 reveals the earnings of married women by age and skill. The married sample includes both widowed and divorced individuals. We use the data of 2017 and adjust to the 2015 level using the CPI. The data are obtained from the 2017 Employment Status Survey (ESS) of the Ministry of Internal Affairs and Communications (MIC).

As shown in Figure 1b, we compute the average LTC expenditures for men H_{pm} from the SLBE data in 2015 by combining the demographic data from the IPSS data in 2015. Further, we calculate the average medical expenditures for men $M_i(j^p)$ for $i \in \{pf, pm\}$ from the National Medical Expenses of the MHLW in 2015.

4.3 Skill and Endowments

The skill inheritance transition probabilities Ω is calibrated to match to both the ratio of high-skilled individuals in the working age population and correlation between the income of parents and children. The ratio of high-skilled individuals is 31%, as reported in the 2017 Employment Status Survey (ESS) of the Ministry of Internal Affairs and Communications (MIC). We use the estimated value of the correlation between the income of parents and children by Lefranc et al. (2014). Subsequently, the skill inheritance transition probabilities are set at $\{\Omega_{LL}, \Omega_{LH}, \Omega_{HL}, \Omega_{HH}\} = \{0.797, 0.203, 0.448, 0.552\}$. The distribution of skill combination between parents and children is $\{0.549, 0.139, 0.139, 0.172\}$.

The age-specific deterministic labor productivity $\epsilon(j^k, z)$ for married women is calibrated from their earnings, based on the ESS of the MIC. We use the 2017 ESS data and adjust to the 2015 level using the consumer price index (CPI). Figure 3 reports the life cycle earnings' profiles for married women by age and skill, for calibrating married women's labor productivity.

To capture the labor supply at the extensive and intensive margins, this study introduces both average working hours and average disposal income for married women across ages. We normalize the disposable time to 1.0 and calibrate the average working hours using the 2016 Time Use Survey of the MIC.

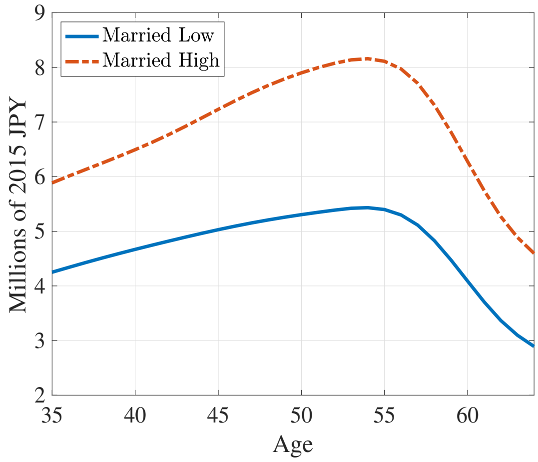


Figure 4: Average Earnings of Married Men by Age and Skill

Note: Figure 4 reveals the average earnings of married men by age and skill. The married sample includes both widowed and divorced individuals. We use the data of 2017 and adjust to the 2015 level using the CPI. The data are obtained from the 2017 Employment Status Survey (ESS) of the Ministry of Internal Affairs and Communications (MIC).

Based on Hsu and Yamada (2019), we take $\Theta = 0.98$ and variance $\sigma_\varsigma = 0.09$ and we discretize this process into a three-state Markov chain by Tauchen (1986). Thereafter, the resulting value of μ is $\{0.40, 1.00, 2.47\}$, and the initial distribution $\overline{\Lambda}(\mu)$ is $\{0.21, 0.58, 0.21\}$.

Average men's earnings $y_m(j^k, z)$ vary with age and skill deterministically. They are computed using the ESS data on married men's average earnings. We use the data of 2017 and adjust to the 2015 level using the CPI. Figure 4 reveals married men's life cycle profiles of average earnings by age and skill.

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

4.4 Care Arrangements

We calibrate the average cost of FHC per hour using the CSLC data for 2016 and obtain p_{LTC} as 0.176 (10,000 yen, CPI adjusted in 2015). The minimum requirement of annual care hours is set at 1013.09 hours and 2017.58 hours for light and heavy LTC statuses, respectively, based on the average annual care hour from the CSLC, described in Table 3.

For the institutional FHC cost, we use the 2016 Survey of Institutions and Establishments for Long-term Care of the MHLW. The data report the average cost for different types of expenditures for institutional care services by the LTC-need level. We compute the average FC service cost in public NH, 372.83 (10,000 yen, CPI adjusted in 2015). Further, we set the required average consumption of the public NH at 121.20 (10,000 yen). LTC recipients in public NH must pay for their living costs. This study calibrates living costs as the sum of the residence fee, food fee, and daily living expenses.[27]

For the parameters in the second group, we set the returns to the care input hours A, IC-FHC substitutability ρ, FHC productivity θ_h, the preference parameter for a public NH relative to community-based care ξ, and the preference parameter for IC relative to FHC ω, respectively. We calibrate these parameters to ensure that the model achieves the target values from the data. The target value of A represents the average annual LTC hours, 1291.96 hours, based on the average annual care hours from the CSLC, reported in Table 3. From the CSLC, we calculate the target values of ρ and θ_h—namely, IC-FHC hours correlation and the ratio of FHC hours to total hours, respectively. For the IC-FHC hours, as in Daruich (2018), we group the eligible individuals by the quartile of FHC hours,[28] compute average annual hours for IC and FHC for each quartile, and calculate the correlation between the two averages. The target values of ξ and ω are the share of institution users and ratio of IC users, described in Tables 2 and 4. See Table 6 for the model generated and target values of the parameters.

4.5 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 estimation in the model. The subjective discount factor β is set at 0.9799 to ensure the model achieves the average per adult equivalent wealth of 823.93 (10,000 yen, CPI-adjusted in 2015), based on Kitao and Yamada (2019), who use the 2014 National Survey of Family Income and Expenditure (NSFIE).

We set the intensity of leisure in the utility function γ at 0.5 to correspond to women's average labor force participation, 70.71%, based on the data used in Fukai et al. (2021). The calibrated value of γ is in the range of values used in the literature. For example, Fuster et al. (2007) set the intensity of leisure at 0.63, and Gao (2021) estimates it to 0.42, as estimated in the model. See Table 6 for the model generated values and target values of the parameters.

[27]The average residence fee is set at 58.83 (10,000 yen), as the average standard amount of residence fee by different types of institutions. The data are obtained from the 2016 Survey of Institutions and Establishments for Long-term Care of the MHLW. The average food fees are set at 50.37 (10,000 yen) by the standard amount of food fee, and the living costs are set at 12 (10,000 yen). For details of the standard amount of living costs, see, for example, https://www.kaigokensaku.mhlw.go.jp/commentary/fee.html (in Japanese).

[28]We compute the average annual FHC hours by the total expenditures and the average cost of FHC per hour p_{LTC} using CSLC data in 2016.

4.6 Government

The government operates the LTCI, health insurance, pay-as-you-go public pension, and means-tested welfare transfer program. The copayment ratio of LTCI λ^h is set to 10% for all ages. LTCI covers 90% of the LTC expenditures for both FHC and NH services.

Publicly provided health insurance also covers part of the medical expenditure, and its copayment ratio λ^m_{jp} varies with age. λ^m_{jp} is set to 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 to one-third, based on an estimate of the average gross replacement rate of public pensions from OECD (2019).

The means-tested welfare program in our model provides a means-tested transfer to eligible households. The consumption floor is set at 87 and 132 (10,000 yen) for widowed and married couples, respectively.[29]

We set the consumption tax rate at 8% based on the tax rate in 2015. Further, we set the labor and capital tax rates at 30% and 35%, respectively, based on Gunji and Miyazaki (2011) and Kitao and Mikoshiba (2020)—in line with the estimates of effective income tax rates in the literature.[30]

[29]The amount is set to lie in the range of average payments of the Public Assistance (*seikatsu-hogo*) program by the family size. The monthly payment is multiplied by 12. For further details regarding the program, see, for example, https://www.mhlw.go.jp/content/12002000/000488808.pdf (in Japanese).

[30]For example, Hansen and İmrohoroğlu (2016) estimates the capital income tax rate in 2010 at 35.6%.

Table 5: External Parameters of the Model

Parameter	Description	Value/Source
Demographics		
J	Lifetime span	30 (initial age corresponds to 35)
ν_g	Population growth	0
η	Equivalence scale	Bick and Choi (2013)
LTC and Mortality risk, and LTC and Medical expenditures		
Ψ	LTC transition probabilities	Mikoshiba et al. (2022)
$n^p(j^p, h)$	Number of parent generation	Mikoshiba et al. (2022)
$M_g^m(j^p)$	Avg. gross LTC expenditure	SLBE (2015) by MHLW
$M_m^h(j^p)$	Avg. gross medical expenditure	NME (2015) by MHLW
Endowments		
$\epsilon(j^k, z)$	Avg. Earnings of married female	ESS (2017) by MIA
$\overline{WH}_{yf}(j^k)$	Avg. working hour	Time use survey (2016) by MIA
$\overline{DH}_{yf}(j^k)$	Avg. disposal time	Time use survey (2016) by MIA
Θ	Shock of productivity	0.98, Hsu and Yamada (2019)
σ_ζ	Shock of productivity	0.09, Hsu and Yamada (2019)
$y_m(j^k, z)$	Avg. earnings of married male	ESS (2017) by MIA
Ω	Skill inheritance transition	Lefranc et al. (2014), ESS (2017) by MIA
$\bar{l}_{cm}, \bar{l}_{pm}, \bar{l}_{pf}$	Avg. leisure time	0.54, 0.54, 0.50
		Time use survey (2016) by MIA
Care Arrangement		
p_{LTC}	Avg. cost of FHC per hour	0.176 (10,000 yen), CSLC (2016) by MHLW
χ_h	Minimum requirement of care hours	$\{1013.09, 2017.58\}$, CSLC (20016) by MHLW
$\bar{c}$	Minimum consumption level in NH	121.20 (10,000 yen), SIEL by MHLW(2016)
$\bar{q}$	Avg. FC cost in NH	327.83 (10,000 yen), SIEL by MHLW(2016)
Preference		
σ	Risk aversion parameter	3.0
Government		
λ^h	LTC insurance copay. rates	10%
$\lambda_{j^p}^m$	Health insurance copay. rates	30, 20, 10% (varies by age)
τ^c	Consumption tax rates	8%
τ^a	Labor income tax rates	30%, Gunji and Miyazaki (2011)
τ^l	Capital income tax rate	35%, Kitao and Mikoshiba (2020)
κ	Public pension replacement rate	1/3, OECD (2019)
$\underline{c}$	Consumption floor	87 for widowed, 132 for married (10,000 yen)
Other Prameter		
r	Interest rate	2%, Aoki et al. (2016)

Table 6: Internal Parameters of the Model

Parameter	Values	Description	Target	Data	Model
Preference					
β	0.9799	Subjective discount factor	Avg. per adult equiv wealth	823.93	814.38
γ	0.5000	Intensity of leisure	Avg. FLFP rate	0.7071	0.7127
Care Arrangements					
A	2.5625	Returns to care input hours	Avg. annual LTC hours	1291.9	1286.9
ρ	0.4100	IC-FHC substitutability	IC-FHC hours correlation	-0.385	-0.494
$\theta_{h=2}$	0.4100	FHC productivity (Light)	IC hours ratio in total (Light)	0.5541	0.5945
$\theta_{h=3}$	0.5300	FHC productivity (Heavy)	IC hours ratio in total (Heavy)	0.4754	0.4755
ω	1.5000	Preference for IC	Ratio of IC user	0.9240	0.9455
ξ	2.4922	Preference for NH	Ratio of community users	0.6103	0.6103

5 Numerical Analysis

First, we discuss the baseline model's outcome. Subsequently, we simulate the policy experiments. Further, we elucidate how universal LTCI with a benefits-in-kind policy affects the individual's behavior over the life cycle and influences tax revenues and welfare.

5.1 Baseline Model

In this section, we present the family care arrangement at the baseline. Table 7 reports care arrangements for community residents by the LTC-need level group. Table 7 illustrates the distribution of care arrangements within the community based on three types of care provision—only IC, mixed IC and FHC, and only FHC. Relative to the distribution pattern in the data, the model replicates the overall pattern of care arrangements well. In other words, the simultaneous use of IC and FHC is high for both light and heavy LTC statuses, and the use of only FHC increases and that of only IC decreases with an increase in the LTC-need level's severity. Table 7 reports that, by the LTC-need level group, this model also captures the burden of the total annual care hours and ratio of IC hours to total care hours.

As discussed in Section 3.10, the opportunity cost of middle-aged married women and amount of household savings are the two main mechanisms determining the family care arrangements. To understand these two mechanisms, Table 8 presents family care arrangements by combining the older parent's and adult child's skill types (s_p, s_k) at baseline. Notably, household savings depend on the older adult parent's skill because the labor earnings of high-skilled married couples are higher than those of low-skilled married couples. Given this, if the older parent's educational level is high, the savings

Table 7: Distribution of Care arrangements in the Baseline Model: Model and Data

		Model	Data
Aggregate	Distribution		
	Only IC	16.54 %	18.89%
	Mix IC-FHC	78.01 %	73.51%
	Only FHC	5.45 %	7.60%
	Total Care hours	1286.93 h	1291.96 h
Light	Distribution		
	Only IC	22.10%	20.52%
	Mix IC-FHC	73.61%	73.69%
	Only FHC	4.29%	5.79%
	Total Care hours	1065.59 h	1013.09 h
Heavy	Distribution		
	Only IC	0.00%	10.63%
	Mix IC-FHC	91.09%	76.44%
	Only FHC	8.91%	12.93%
	Total Care hours	1945.87 h	2017.58 h

of a high-skilled older parent will be higher than those of a low-skilled parent. Then, the opportunity cost of providing IC becomes lower for adult children with low-skilled parents.

Table 8 reveals that the use of IC only in a family with low-skilled, middle-aged children is higher than that in a family with high-skilled, middle-aged children. This is because if the middle-aged children's educational skill is low, their IC opportunity costs will be lower than that for high-skilled children.

The first row in Table 8 reveals that the IC to total hours ratio is high for families with a highly educated older parent and low-skilled adult children. The mechanism of the amount of household savings dominates that of middle-aged married women's opportunity cost in the labor market when households face a trade-off between a reduction in the current labor income of middle-aged married women because of using IC, and a smaller bequest from a savings cut-off to purchase formal care services. This is because of the exogenous sufficient labor income from middle-aged married men in the baseline.

Notably, this model does not capture extremely poor families. Although recipients of welfare programs constitute approximately 2% of the population in the data, the number of means-tested welfare transfer recipients at the baseline is only 0.31% of the population. This is because this model focuses on married older households with married middle-aged children, wherein middle-aged married men's labor force participation is extremely high, and their average earnings are high enough, as presented in Figure 4. This assumption is reasonable to capture the characteristics of cohort households born between the 1950s and 1980s.

Table 8: Distribution of Care arrangements in the Baseline Model by Skill Type

		(High, Low)	(High, High)	(Low, Low)	(Low, High)	Average
Aggregate	Ratio of IC hours to total hours	68.21 %	52.33 %	52.20 %	44.84 %	53.43 %
	Distribution					
	Only IC	33.45 %	21.66 %	9.87 %	14.97 %	16.54 %
	Mix IC-FHC	66.54 %	66.30 %	88.72 %	70.29 %	78.01 %
	Only FHC	0.01 %	12.04 %	1.41 %	14.74 %	5.45 %
Light	Distribution					
	Only IC	52.99 %	32.49 %	12.05 %	22.38 %	22.10%
	Mix IC-FHC	46.99 %	58.51 %	86.23 %	65.29 %	73.61%
	Only FHC	0.22 %	9.00 %	1.72 %	12.33 %	4.29%
Heavy	Distribution					
	Only IC	0.00%	0.00 %	0.00 %	0.00 %	0.00%
	Mix IC-FHC	100.00%	81.88 %	100.00 %	80.40 %	91.09%
	Only FHC	0.00%	18.12 %	0.00 %	19.60 %	8.91%

5.2 Policy Experiments

Japan's LTCI system is universal and covers all citizens aged 65 years and older eligible for LTCI. Japanese LTCI provides only services and no cash allowance. Eligible individuals can choose their LTC services from the market with a copayment ratio of 10%.

To understand the LTCI's roles, we simulate the model under different LTCI systems from the baseline and evaluate how the policy change affects the households' behavior and heterogeneous households' welfare. First, we evaluate universal LTCI's roles under the extreme scenario wherein no LTCI is provided. Second, we evaluate the roles of LTCI with a benefits-in-kind policy by considering an alternative scenario wherein the LTCI system provides only cash benefits. The welfare measure is computed as a percentage change in consumption required in all possible states, which ensures that individuals are indifferent between the baseline and simulated scenarios.

5.2.1 An Economy without LTCI

To evaluate the universal LTCI system's roles, we first consider an extreme scenario wherein no LTCI is provided. First, we simulate the scenario without tax adjustment to focus on changes in different household risks over the life cycle and isolate governmental LTC expenditure's effects. In the first simulation, we set G to absorb the imbalance and satisfy Equation (3). In the second simulation, we adjust a lump-sum tax rate τ^{ls} to account for a change in the net government revenues to balance the government budget in Equation (3).

Table 9 presents the extreme scenario of an economy without LTCI and the changes in aggregate variables of households' behavior and heterogeneous households' welfare effects. In the scenario without tax adjustment, the average ratio of IC hours to total hours would be almost 60% higher owing to the higher cost of formal care under no LTCI. The increase

Table 9: An Economy without LTCI

	No tax change	Tax adjusted
Change in avg. IC ratio		
- Average	+ 60.915 %	+ 61.220 %
- (High, Low)	+ 29.583 %	+ 29.663 %
- (High, High)	+ 62.287 %	+ 62.473 %
- (Low, Low)	+ 65.509 %	+ 65.980 %
- (Low, High)	+ 85.833 %	+ 85.924 %
Change in avg. FLFP	- 9.072 %	- 9.859 %
Change in avg. savings	+ 9.563 %	+ 9.668 %
Welfare Program Recipients	0.954 %	0.904 %
	(+203.825 %)	(+188.016 %)
Lump-sum tax (JPY)	-	-80,674.423
Welfare effects		
- Average	- 2.200 %	- 1.302 %
- (High, Low)	- 1.996 %	- 1.203 %
- (High, High)	- 1.761 %	- 1.163 %
- (Low, Low)	- 2.373 %	- 1.353 %
- (Low, High)	- 2.065 %	- 1.313 %

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

in IC ratio is particularly large for households incurring a high cost for providing IC in the baseline. The additional increase in IC ratios would reduce the labor force participation of middle-aged married women by almost 10% on average. Average savings would rise by almost 10% because households would likely accumulate more precautionary savings owing to the higher cost of formal care. The number of welfare program recipients would rise dramatically from 0.31% of the population in the baseline to 0.95%. Given this, the welfare effects would be strictly negative in the scenario without tax adjustment. The welfare loss is particularly large for households with both low-skilled older parent and adult child.

When lump-sum taxes are adjusted to balance the government budget, each household would receive an annual subsidy of almost 80,000 yen. Compensation from the lump-sum transfer would increase the IC ratio in total hours because households would be incentivized to prevent cutting down on an additional bequest. Given this, women's labor force participation would be lower and the average saving would be higher, relative to the scenario without tax adjustment. The increase in the number of welfare program recipients is higher relative to the baseline but smaller than the scenario without tax adjustment. Despite the compensation, the welfare effect would still be negative. This is because the amount of lump-sum transfer would not be sufficient to compensate for the huge burden of care.

Experiments with no universal LTCI reveal that universal LTCI protects households well against LTC risk in old age. When the government eliminates the LTCI system, the cost of formal care services would exceed that at the baseline, and households would cope with the burden of care by providing more IC, which would precipitate a decline in middle-aged married women's average labor force participation. In the absence of LTCI, LTC risk may induce greater precautionary savings. However, in poorer households, the massive burden of care would deplete the savings, which, in turn, would compel these households to turn to the welfare program. Given this, reductions in government expenditure from eliminating LTCI may be offset by higher expenditures for the welfare program. Consequently, the welfare effects would be strictly negative, even if a lump-sum tax is adjusted to balance the government budget because the compensation through a lump-sum tax would be insufficient to cover significant LTC burdens with higher expenditures for the welfare program.

5.2.2 Roles of Benefits-in-kind

To understand the roles of LTCI with a benefits-in-kind policy, we simulate an alternative scenario wherein the LTCI system provides only cash benefits and the copayment ratio is 100%. We set the amount of cash benefits to allow the use of the average FHC services in the baseline model—corresponding to 83,625 yen and 179,678 yen for light and heavy LTC statuses, respectively. Table 10 presents the changes in the aggregate variables of households' behavior and heterogeneous households' welfare effects.

When there is no tax adjustment, the IC ratios in total hours would rise by approximately 63% owing to the higher price of FHC. Correspondingly, caregivers' labor force participation and households' average savings would fall by approximately 9.0% and 9.7%, respectively. The savings incentive would be smaller than that in the baseline because the cash transfers compensate for the reduction in labor income of middle-aged married women, resulting from an increased IC. With the cash transfer compensation, the number of welfare programs recipients would be lower than that in the baseline model, and welfare effects would be positive for all combinations of skill types.

The second row in Table 10 reveals that LTCI with cash benefits would require about 1,800 yen from each household. The cash benefits would increase IC and, simultaneously, decrease tax revenues from the labor income of middle-aged married women and capital income, thereby precipitating the imposition of a lump-sum tax. Hence, the increase in welfare effects from cash transfers would be slightly mitigated by the lump-sum tax.

The overall ratio of IC would be slightly higher with the lump-sum tax than that with no tax adjustment. However, this increase in the ratio of IC can be attributed to a low-skilled older parent and adult children. For a low-skilled older parent and adult children, the lump-sum tax would reduce the savings required to purchase formal care services, which, in turn, would compel households to turn to IC or a welfare program. Regarding households, except for low-skilled older parent and adult children, the lump-

Table 10: An Economy with Cash Benefits to allow average FHC in the Baseline

	No tax change	Tax adjusted
Change in avg. IC ratio		
- Average	+ 63.703 %	+ 63.706 %
- (High, Low)	+ 28.757 %	+ 28.756 %
- (High, High)	+ 63.921 %	+ 63.920 %
- (Low, Low)	+ 70.421 %	+ 70.427 %
- (Low, High)	+ 85.778 %	+ 85.777 %
Change in avg. FLFP	- 8.938 %	- 8.925 %
Change in avg. savings	- 9.665 %	- 9.676 %
Welfare Program Recipients	0.000 %	0.000 %
	(-100.000 %)	(-100.000 %)
Lump-sum tax (JPY)	-	+ 1,857.724
Welfare effects		
- Average	+ 1.544 %	+ 1.531 %
- (High, Low)	+ 1.320 %	+ 1.309 %
- (High, High)	+ 0.942 %	+ 0.935 %
- (Low, Low)	+ 1.797 %	+ 1.780 %
- (Low, High)	+ 1.231 %	+ 1.221 %

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

sum tax would slightly reduce IC because the mechanism of household savings would be weakened by the lump-sum tax.

Although only services are provided in Japanese LTCI, universal LTCI systems, as in Germany and South Korea, allow older people in need of care to choose between benefits-in-kind and cash benefits. In these countries, the amount of cash benefits is less generous than the value of corresponding benefits-in-kind services. For example, in Germany, the amount of cash benefits is 40% to 50% lower than the value of benefits-in-kind, depending on the LTC-level need group. To elucidate the effects of cash benefits' generosity, Table 11 presents the simulation results when we assume different degrees of this generosity. In the two experiments, we adjust the amount of cash benefits to allow the use of 50% or 40% of the amount of FHC services in the baseline model.

Table 11 reveals that welfare gains depend on cash benefits' generosity. Irrespective of cash benefits's generosity, the IC ratio in total hours would rise owing to the higher price of FHC than the baseline model. In comparison to Table 10, we find that as generosity decreases, average savings and the number of welfare programs recipients rise, and welfare effects worsen. Cash benefits are especially beneficial to low-skilled adult children, but less beneficial for high-skilled adult children.

These experiments reveal that universal LTCI with a benefits-in-kind policy is more expensive than universal LTC with cash benefits, even though LTCI with a benefits-in-kind policy does not significantly discourage the labor supply of middle-aged married

Table 11: Alternative Generosity of Cash Benefits

	50 % of average FHC in the baseline		40 % of average FHC in the baseline	
	No tax change	Tax adjusted	No tax change	Tax adjusted
Change in avg. IC ratio				
- Average	+ 63.342 %	+ 63.499 %	+ 62.909 %	+ 63.252 %
- (High, Low)	+ 29.750 %	+ 29.752 %	+ 29.793 %	+ 29.823 %
- (High, High)	+ 62.842 %	+ 63.054 %	+ 62.665 %	+ 62.929 %
- (Low, Low)	+ 69.812 %	+ 70.029 %	+ 69.043 %	+ 69.583 %
- (Low, High)	+ 85.759 %	+ 85.778 %	+ 85.840 %	+ 85.860 %
Change in avg. FLFP	- 9.152 %	- 9.676 %	- 9.127 %	- 9.631 %
Change in avg. savings	- 0.629 %	- 1.305 %	+ 1.508 %	+ 0.745 %
Welfare Program Recipients	0.290 %	0.262 %	0.415 %	0.361%
	(- 7.547 %)	(- 16.519 %)	(+ 32.338 %)	(+ 14.966 %)
Lump-sum tax (JPY)	-	- 42,136.738	-	- 50,304.385
Welfare effects				
- Average	- 0.627 %	+ 0.122%	- 1.051 %	- 0.154 %
- (High, Low)	- 0.680 %	+ 0.022%	- 1.060 %	- 0.218 %
- (High, High)	- 0.722 %	- 0.134%	- 1.040 %	- 0.334 %
- (Low, Low)	- 0.584 %	+ 0.230%	- 1.053 %	- 0.078 %
- (Low, High)	- 0.669 %	- 0.010%	- 1.047 %	- 0.256 %

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

women who are caregivers. Experiments suggest that less generous cash benefits can potentially reduce government LTC expenditure by replacing high-cost formal care services with care provided by family members. However, welfare gains depend on cash benefits' generosity. Thus, welfare effects would worsen as generosity decreases.

6 Conclusion

This study examines how LTC risks affect an individual's behavior over the life cycle and analyzes the roles of the LTCI system in Japan, which has the oldest population in the world. This study quantifies LTCI's welfare effects on heterogenous households, relative to alternative policies, and focuses on the role of the universal LTCI system with a benefits-in-kind policy. We build a structural overlapping generations model with two-sided altruism. To develop a richer model of family care arrangements, our model incorporates different types of care options—IC, FHC, and NH. This model endogenizes family care arrangements by two-stage family decisions.

We focus on the two features of Japanese LTCI—universal insurance and a benefits-in-kind policy. This study removes the LTCI system and considers the role of LTCI and its interaction with welfare programs. We find that universal LTCI protects households well against LTC risks in old age. Owing to a significant burden of care and in the absence of a universal LTCI system, households turn to informal care or a welfare programs. However, even if a lump-sum tax is adjusted to balance the government budget, the compensation falls short in covering the significant LTC burdens. Hence, the welfare effects are strictly negative. Moreover, the effects are not uniform across individuals. Households with both a low-skilled older parent and adult children would exhibit the highest preference for IC services and the largest welfare loss.

Furthermore, we consider the roles of LTCI with a benefits-in-kind policy by simulating the scenario wherein the LTCI system provides only cash benefits. Universal LTCI with a benefits-in-kind policy is more expensive than universal LTC with cash benefits, even though LTCI with a benefits-in-kind policy does not significantly discourage caregivers's labor supply. Irrespective of tax adjustment, welfare effects are positive when LTCI provides an amount of cash benefits that allows the use of the average FHC services in the baseline model. This is because the ratio of IC would rise due to the higher cost of formal care, but cash benefits compensate for the decline in middle-aged married women's labor income, which is significantly lower than that of men. However, welfare gains depend on cash benefits' generosity—that is, welfare effects would worsen as generosity decreases.

Finally, we discuss the key concerns of—and omissions from—our model, which can be investigated in future research. The first concern is private NH in the LTC market. This study focuses on family care arrangements with three types of care options—IC, FHC, and public NH. Although the percentage of private NH is smaller than that of public NH, the number of private NH is growing rapidly. This is because private NH supplies a higher quality of care and housing than that of the public NH. These services are predominantly utilized by high-income households. Thus, evaluating private NH may be important in understanding the impact on richer families.

The second concern is the accumulation of human capital. Middle-aged informal caregivers would face lower earnings and wage growth. This concern would be crucial for countries with rigid labor markets such as Japan. Cash benefits can potentially reduce government LTC expenditure and are especially beneficial to low-skilled adult children. However, alleviating restrictions on the labor supply of high-skilled adult children may be important—particularly in countries such as Japan, where the labor force is rapidly declining and the number of caregivers in the LTC market is insufficient. However, this may not be a significant concern because adult children caregivers are typically close to the end of their careers.

Moreover, we leave the evaluation of demographic changes' impact to future research. This study considers a stationary equilibrium; such a model does not consider demographic changes' impact. Importantly, changes in the family structure are crucial to the economic and welfare evaluations of alternative policy reforms, and the fiscal sustainability of the insurance system. Specifically, the care options available to individuals are highly dependent on the family structure, which must be investigated in the future.

References

Ameriks, J., J. Briggs, A. Caplin, M. D. Shapiro, and C. Tonetti (2020). Long-term-care utility and late-in-life saving. *Journal of Political Economy 128*(6), 2375–2451.

Ando, M., M. Furuichi, and Y. Kaneko (2021). Does universal long-term care insurance boost female labor force participation? Macro-level evidence. *IZA Journal of Labor Policy 11*(1).

Aoki, K., A. Michaelides, and K. Nikolov (2016). Household portfolios in a secular stagnation world: Evidence from Japan. Bank of Japan Working Paper Series, No.16-E-4.

Applebaum, R. A., J. B. Christianson, M. Harrigan, and J. Schore (1988). The evaluation of the national long term care demonstration. 9. The effect of channeling on mortality, functioning, and well-being. *Health Services Research 23*(1), 143.

Attanasio, O., S. Kitao, and G. L. Violante (2010). Financing medicare: A general equilibrium analysis. In *Demography and the Economy*, pp. 333–366. University of Chicago Press, Chicago.

Auerbach, A. J., L. J. Kotlikoff, et al. (1987). *Dynamic fiscal policy*. Cambridge University Press, Cambridge.

Barczyk, D., S. Fahle, and M. Kredler (2019). Save, spend or give? A model of housing, family insurance, and savings in old age. In *2019 meeting papers*, Volume 361. Society for Economic Dynamics.

Barczyk, D. and M. Kredler (2017). Evaluating long-term-care policy options, taking the family seriously. *The Review of Economic Studies 85*(2), 766–809.

Barczyk, D. and M. Kredler (2019). Long-term care across Europe and the United States: The role of informal and formal care. *Fiscal Studies 40*(3), 329–373.

Bick, A. and S. Choi (2013). Revisiting the effect of household size on consumption over the life-cycle. *Journal of Economic Dynamics and Control 37*(12), 2998–3011.

Bolin, K., B. Lindgren, and P. Lundborg (2008). Informal and formal care among single-living elderly in Europe. *Health economics 17*(3), 393–409.

Bonsang, E. (2009). Does informal care from children to their elderly parents substitute for formal care in Europe? *Journal of Health Economics 28*(1), 143–154.

Braun, R. A., K. A. Kopecky, and T. Koreshkova (2017). Old, sick, alone, and poor: A welfare analysis of old-age social insurance programmes. *The Review of Economic Studies 84*(2), 580–612.

Braun, R. A., K. A. Kopecky, and T. Koreshkova (2019). Old, frail, and uninsured: accounting for features of the us long-term care insurance market. *Econometrica 87*(3), 981–1019.

Brown, J. R. and A. Finkelstein (2008). The interaction of public and private insurance: Medicaid and the long-term care insurance market. *American Economic Review 98*(3), 1083–1102.

Bueren, J. (2022). Long-term care needs and savings in retirement.

Campbell, J. C. and N. Ikegami (2000). Long-term care insurance comes to Japan: A major departure for Japan, this new program aims to be a comprehensive solution to the problem of caring for frail older people. *Health affairs 19*(3), 26–39.

Charles, K. K. and P. Sevak (2005). Can family caregiving substitute for nursing home care? *Journal of health economics 24*(6), 1174–1190.

Daruich, D. (2018). The macroeconomic consequences of early childhood development policies. *Available at SSRN 3265081*.

Davidoff, T. (2010). Home equity commitment and long-term care insurance demand. *Journal of Public Economics 94*(1-2), 44–49.

De Nardi, M., E. French, and J. B. Jones (2010). Why do the elderly save? The role of medical expenses. *Journal of Political Economy 118*(1), 39–75.

De Nardi, M., E. French, and J. B. Jones (2016). Medicaid insurance in old age. *American Economic Review 106*(11), 3480–3520.

Fu, R., H. Noguchi, A. Kawamura, H. Takahashi, and N. Tamiya (2017). Spillover effect of Japanese long-term care insurance as an employment promotion policy for family caregivers. *Journal of health economics 56*, 103–112.

Fukai, T., H. Ichimura, S. Kitao, and M. Mikoshiba (2021). Medical expenditures over the life-cycle: Persistent risks and insurance. *RIETI Discussion Paper Series 21-E-073*.

Fukuda, S., S. Yoda, and R. Mogi (2019). Educational assortative mating in Japan: Evidence from the 1980-2010 census. *IPSS Working Paper Series*.

Fuster, L., A. İmrohoroğlu, and S. İmrohoroğlu (2007). Elimination of social security in a dynastic framework. *The Review of Economic Studies 74*(1), 113–145.

Gao, H. (2021). Social security and female labor supply in China.

Geyer, J. and T. Korfhage (2015). Long-term care insurance and carers' labor supply–a structural model. *Health economics 24*(9), 1178–1191.

Groneck, M. (2017). Bequests and informal long-term care evidence from hrs exit interviews. *Journal of Human Resources 52*(2), 531–572.

Gunji, H. and K. Miyazaki (2011). Estimates of average marginal tax rates on factor incomes in Japan. *Journal of the Japanese and International Economies 25*(2), 81 – 106.

Hamaaki, J., M. Hori, and K. Murata (2019). The intra-family division of bequests and bequest motives: Empirical evidence from a survey on Japanese households. *Journal of Population Economics 32*(1), 309–346.

Hanaoka, C. and E. C. Norton (2008). Informal and formal care for elderly persons: How adult children's characteristics affect the use of formal care in Japan. *Social Science & Medicine 67*(6), 1002–1008.

Hansen, G. D. and S. İmrohoroğlu (2016). Fiscal reform and government debt in Japan: A neoclassical perspective. *Review of Economic Dynamics 21*, 201–224.

Hsu, M. and T. Yamada (2019). Population aging, health care, and fiscal policy reform: The challenges for Japan. *The Scandinavian Journal of Economics 121*(2), 547–577.

İmrohoroğlu, A. and K. Zhao (2018). The Chinese saving rate: Long-term care risks, family insurance, and demographics. *Journal of Monetary Economics 96*, 33–52.

Kitao, S. and M. Mikoshiba (2020). Females, the elderly, and also males: Demographic aging and macroeconomy in Japan. *Journal of the Japanese and International Economies 56*, 101064.

Kitao, S. and T. Yamada (2019). Dimensions of inequality in Japan: Distributions of earnings, income and wealth between 1984 and 2014.

Ko, A. (2022). An equilibrium analysis of the long-term care insurance market. *The Review of Economic Studies 89*(4), 1993–2025.

Kopecky, K. A. and T. Koreshkova (2014). The impact of medical and nursing home expenses on savings. *American Economic Journal: Macroeconomics 6*(3), 29–72.

Koreshkova, T. and M. Lee (2020). Nursing homes in equilibrium: Implications for long-term care policies. *Available at SSRN 3885803*.

Lefranc, A., F. Ojima, and T. Yoshida (2014). Intergenerational earnings mobility in Japan among sons and daughters: levels and trends. *Journal of Population Economics 27*(1), 91–134.

Lockwood, L. M. (2018). Incidental bequests: Bequest motives and the choice to self-insure late-life risks. *American Economic Review 108*(9), 2513–2550.

Mikoshiba, M., H. Noguchi, and A. Kawamura (2022). Long-term care shocks over the life-cycle in Japan.

Mommaerts, C. (2015). Long-term care insurance and the family.

Mommaerts, C. (2018). Are coresidence and nursing homes substitutes? Evidence from medicaid spend-down provisions. *Journal of health economics 59*, 125–138.

OECD (2019). *Pensions at a Glance 2019*. Organizations for Economic Co-operation and Development.

Pashchenko, S. (2013). Accounting for non-annuitization. *Journal of Public Economics 98*, 53–67.

Shimizutani, S., W. Suzuki, and H. Noguchi (2008). The socialization of at-home elderly care and female labor market participation: Micro-level evidence from Japan. *Japan and the World Economy 20*(1), 82–96.

Skira, M. M. (2015). Dynamic wage and employment effects of elder parent care. *International Economic Review 56*(1), 63–93.

Sugawara, S. and J. Nakamura (2014). Can formal elderly care stimulate female labor supply? The Japanese experience. *Journal of the Japanese and International Economies 34*, 98–115.

Suzuki, W., Y. Iwamoto, and M. Yuda (2012). The distribution patterns of medical care and long-term care expenditures: Estimations based on administrative data in Fukui prefecture. *Japanese journal of health economics and policy 24*(2), 86–107.

Tamiya, N., H. Noguchi, A. Nishi, M. R. Reich, N. Ikegami, H. Hashimoto, K. Shibuya, I. Kawachi, and J. C. Campbell (2011). Population ageing and wellbeing: lessons from Japan's long-term care insurance policy. *The Lancet 378*(9797), 1183–1192.

Tauchen, G. (1986). Finite state Markov-chain approximations to univariate and vector autoregressions. *Economics letters 20*(2), 177–181.

Tsutsui, T. and N. Muramatsu (2005). Care-needs certification in the long-term care insurance system of Japan. *Journal of the American Geriatrics Society 53*(3), 522–527.

Van Houtven, C. H., N. B. Coe, and M. M. Skira (2013). The effect of informal care on work and wages. *Journal of Health Economics 32*(1), 240–252.

Van Houtven, C. H. and E. C. Norton (2004). Informal care and health care use of older adults. *Journal of Health Economics 23*(6), 1159–1180.

Yamada, H. and S. Shimizutani (2015). Labor market outcomes of informal care provision in Japan. *The Journal of the Economics of Ageing 6*, 79–88.

Appendix A Computation of the Steady States

In this appendix, we present the algorithms used to compute the steady states 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 $\{\lambda^h, \lambda^m, \tau^c, \tau^a, \tau^l\}$, compute the households' problem.

(a) Guess the value function of No disability of age 1, $V_1(a, z, z', h = 1, \iota_{-1} = 0, \mu)$.

(b) Solve the households' problem by backward induction.

(c) Update the guess of $V_1(a, z, z', h = 1, \iota_{-1} = 0, \mu)$ and iterate until convergence.

Step 3: Compute the set of age-dependent measures of households $\{X\}_{j^k=1}^{J}$ from the policy function in Step 2.

(a) Guess the age-dependent measures of age 1, $X_1(a, z, z', h, \iota_{-1}, \mu)$.

(b) Compute the age-dependent measures to satisfy Equation (4) and (5).

(c) Update the guess of $X_1(a, z, z', h, \iota_{-1}, \mu)$ and iterate until convergence.

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

Step 5: Use Equation (2) and the government's budget conditions to update the guesses $\text{pen}_{pf}(j^p, z)$ and τ^{ls}, if needed.