A proposal for re-designing social security : Long-term care pension

July 2, 2015

Abstract

The public long-term care insurance (hereinafter, LTCI) system was introduced 15 years ago in Japan in April 2000. Although the system has been modified many times to date, further fundamental revisions are required as the society continues to age. The number of certified users also already exceeded 5 million, and will continue to increase. The LTCI has become one of the biggest pillars of "comprehensive reform of taxation and social security." However,finances have been tighter and tighter by the increase in number of care service users, so raising premium for the long-term care insurance and reducing benefit costs is becoming a serious problem.

On the other hand, the maximum premium limits for public pension plans were set in 2004, under which the old-age pension amount is gradually reduced using an automatic-adjustment mechanism known as "macroeconomic indexation" such that the income replacement rate will eventually near 50%.Moreover, themedical insurance also poses another problem that medical expenses are growing so rapidly. Finally the government has made a decision to adopt "comprehensive reform of a social security and tax" which solves the problem simultaneously by raising consumption tax, and reducing social security benefits.

However, surprisingly in Japan, various provisions for the extreme elderly's lifetime income protection seems to be shrinking. Although the employees' welfare pension insurance and national pension insurance were the cores of the system of offering life-long payout pension benefits, the replacement rate of the elderly will reduce to 50% gradually in the long run.

In this paper, I propose the automatic adjustment system of the pension benefits in a certain requiring care level as a new reform policy which performs logically financial adjustment of long-term care insurance and public pension systems. If it falls into a certain required care status, it is necessary to upgrade the level of its required care benefit, and an individual expense burden will also increase. On the other hand, the more it will be in a serious required care status, mortality rates become high and, the more room to raise pension benefit is created. It is the fundamental concept that we may appropriate the increased amount of these pension benefits to use for the increase of required care benefit. Similar ideas are realized in part annuity products in private sector, such as "ADLA (advanced-life delayed annuity)" of U.S, and "impaired pension" of Britain.

Keywords: Public long-term care insurance system Employees' welfare pension insurance National pension insurance Required care level Advanced-life delayed annuity impaired pension Markov chain model transition probability matrix

1 Introduction

The public long-term care insurance (hereinafter, LTCI) system was introduced 15 years ago in Japan in April 2000. Although the system has been modified many times to date, further fundamental revisions are required as the society continues to age. The LTCI has become one of the biggest pillars of "comprehensive reform of taxation and social security." The maximum premium limits for public pension plans were set in 2004, under which the old-age pension amount is gradually reduced using an automatic-adjustment mechanism known as "macroeconomic indexation" such that the income replacement rate will eventually near 50%. Thus, individuals risk coverage power when requiring serious care, leading to a potentially serious longevity risk. The elderly wish to lead as healthy of a life as possible and reduce periods under serious required care by the state. To reduce the elderly longevity risk, in this paper, we propose a "care pension benefit" public pension plan where an automatic benefit increase mechanism corresponds to the required care class.

Part I includes the history, present situation, and future of the public LTCI in Japan in Section 2 as well as an estimation of mortality rates in Section 3 corresponding to required care levels and other components of the state transition probability matrix using data on the LTCI and total population offered by the Ministry of Health, Labor, and Welfare.

Part II includes life-annuity features in Japan in Section 4 and some new trends in annuity products of other advanced countries as well a proposal for a "care pension" system in public pension design in Section 5.

In Section 5, we also introduce the "advanced-life deferred annuities" (ALDAs) similar to the QLAC plan proposed by the U.S. government and "care annuity" product sold in the UK insurance market.

In Section 6, we advocate a feasible automatic benefit increase system based on mortality rates corresponding to the required care levels estimated in Section 4.

Finally, based on our results, we conclude with some comments to provide suggestions for lengthening the life expectancy as much as possible.

2 Long-Term Care Insurance in Japan

2.1 A general description of LTCI plan

Public LTCI is a social insurance system of Japan that responds to the aging society and has been enforced since April 1, 2000.

The insured are 40-years old or older. The "primary insured" are 65 and over, whereas the "secondary insured" are those 40 to 65-years old under medical coverage.

The insurers in this case are municipalities and special wards in the metropolitan area. The central government, prefectures, healthcare insurers, and pension insurers provide them with continuous support and assistance.

A care needs assessment is performed by an insurer based on a certification investigation and is divided into seven stages: required support 1 and 2 and required care 1 to 5. Under the law, required support certifications and care needs assessment are distinguished, and long-term care services are limited under the required support classes. Care managers coordinate various types of long-term care services based on these facts.

We should distinguish between "beneficiaries," who actually receive long-term care services, from "certified participants," who have the right to claim these services. Therefore, there are "beneficiaries" who do not receive the services even if they are already "certified."

Users of LTCI services participate in 10% of the service expenses, and the remaining 90% is covered by public expenditure and LTCI premiums.

LTCI services may be roughly classified into three categories: home care services, community-based services, and institutional care services. In fiscal year 2012, among 4,580,000 service beneficiaries, 870,000 (19.1%) received home care services, 330,000 (7.2%) received community-based services, and 3,380,000 (73.8%) received institutional care services.

Home care services consist of home help services (e.g., bathing, attendance, and rehabilitation) that beneficiaries can receive while staying at home.

Community-based services are services for self-support that combine the core activity of daytime stay in a small-scale facility in the community along with "visiting care" and "transient stays" according to the required care level.

Institutional care services are services that an LTCI beneficiary can receive in a nursing home or a hospital.

The maximum LTCI benefits are setup according to the present required long-term care (RLTC) level, and users can request LTCI services within the limit as long as they cover 10% of total payments. However, if the total payment cost exceeds the limit, users pay the excess cost themselves.

Table 1 shows that an advanced age beneficiary with RLTC 4 or 5 who receives only annuity benefits must pay ¥30,000 or more every month.

Care class	Monthly benefit limit
Required support 1	¥49,700
Required support 2	¥104,000
Required long-term care 1	¥165,800
Required long-term care 2	¥194,800
Required long-term care 3	¥267,500
Required long-term care 4	¥306,000
Required long-term care 5	¥358,300

Table 1: Self-payment amount by care class

Hereinafter, we denote the levels of "required support" as RS1 and RS2 and those of RLTC as RC1–5.

2.2 Present LTCI situation

The number of LTCI beneficiaries has increased rapidly since the LTCI system was enacted in 2000, from 2,181,000 beneficiaries in 2000 to 5,075,000 in 2011, a 2.5-time increase. Furthermore, the ratio of the population aged 75 and over against the total population in Japan will be 18.2% in 2025 and 26.5% in 2055. Total expenditures required to maintain the long-term care system (¥7,900 billion in 2010) are forecast to grow to between ¥19 trillion to ¥23 trillion in 2025, based on trial calculations by the government.

The overwhelming majority of LTCI beneficiaries are female, and they also showed a much higher rate of increase in number of beneficiaries than males did. Female mortality is much lower than male mortality in old ages, and they are more likely to be categorized with a higher RLTC.

Notes: "Transient required care (TRC)" with an asterisk (*) is worth explaining. The classification "TRC" temporarily existed as a transitional phase under "required support (RS)," which used to be a single class. The RS was split into the two classes RS1 and RS2 in fiscal year 2003 in reconciliation with RC1. During this transient time required for reconciliation and conversion to RS2, the TRC was used.

Next, we look at the table of annual number of the beneficiaries classified with RS (RS1, RS2, and the combined transient RS) and with RC 1–5.

After a gradual increase, RC 2 fell for a period and was replaced by RC 1, which begins to increase at the stretch. This change seems to be caused by effects on the care accreditation standards.

fiscal year	2000	2005	2006	2007	2008	2009	2010	2011
Required support 1	290	673	58	527	551	574	603	662
Required support 2	-	-	45	521	629	661	653	668
Transient required care(*)	-	-	654	39	1	0	-	-
Required long-term care 1	551	1332	1386	876	769	788	852	909
Required long-term care 2	393	614	651	755	806	822	854	900
Required long-term care 3	316	527	560	652	711	737	712	699
Required long-term care 4	338	496	524	547	578	589	629	641
Required long-term care 5	290	464	465	488	500	514	563	593
Total	2181	4108	4348	4408	4548	4689	4870	5075

Table 2: Annual trends of the number of beneficiaries by care class (unit: thousands of people)

In the next subsection, we look results of past research on the mortality of those under required care.

2.3 Preceding studies on mortality for cared people

There are few preceding studies on mortality by care class in Japan. Thus, the survey reports on various communities or populations.

- Tachika and Kikuchi(2006) traced 107,531 "primary insured" LTCI beneficiaries in Suginami-ku, Tokyo between April 1, 2000 and October 31, 2003 and estimated transitional probabilities among care classes, but they did not estimate mortality rates.

- Mitoku et al.(2011) reported follow-up results on 2,341 senior citizens (804 males, 1,537 females) aged 65 and over who received RLTC accreditation in cities in the central and mountainous areas from April 2003 to December 2004, classifying mortality rates by age and care class.

age class	65-74	75-84	85+	v
male	10.8	20.8	29.8	20.4
female	5.9	9.4	18.3	12.2

Table 3: Mortality rates by age class (%)

Care level	RS	RC1	RC2	RC3	RC4	RC5
male	14.8	16.2	20.0	24.1	23.2	36.3
female	5.2	7.9	12.6	19.2	18.3	32.3

Table 4: Mortality rates by care class (%)

- Inoue (2012) investigated 13,066 senior citizens who resided in a borough suburban city in September 2001. In her paper, mortality by gender and care class are shown with other transition statistics for a 3-year observation period.

Care level	RS	RC 1	RC 2	RC 3	RC 4	RC 5
male	28.6	28.8	41.0	62.9	53.3	60.4
female	15.5	16.9	22.7	28.0	36.7	48.6

Table 5: Mortality rates by care class (%)

- Okamoto (2004) reported an experience mortality survey for 7,000–8,000 cared residents in Nishinomiya-shi, Hyogo prefecture in 2001 to 2003 in his blog, followed by a similar survey in Matsue city, Shimane prefecture for a 2-year follow-up.

Care level	RS	RC 1	RC 2	RC 3	RC 4	RC 5
Matsue	8.8	14.8	20.4	23.9	32.7	41.4
Nishinomiya	11.5	15.0	22.2	24.5	34.3	45.8

Table 6: Experience study on mortality rates in Matsue city and Nishinomiya city (%)

Although some differences exist, a similar trend exists among these surveys that the mortality for cared people is proportional to their required care level and age.

Finally, we obtain the following table to compare the estimated mortality rates with those of the preceding studies, in which labels 1 to 6 on the x axis indicate RS and RC1–5. Moreover, bars 1 and 2 from the left side indicate male and female mortality in Mitoku(2011), respectively, bars 3 and 4 indicate male and female mortality in Inoue(2012), respectively, and bars 5 and 6 respectively indicate aggregate mortality of Nishinomiya and Matsue in Okamoto(2004).

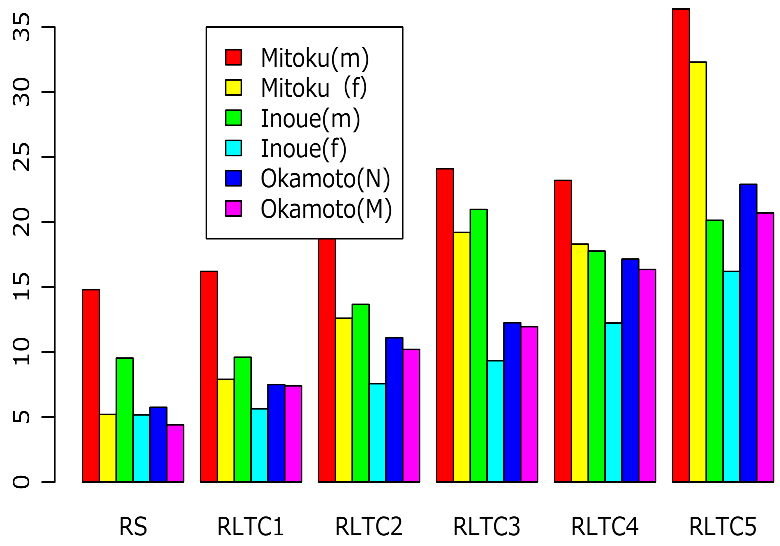

Figure 1: Mortality comparison in preceding studies

3 Estimation of transition matrix for care class

3.1 Estimation steps

LTCI beneficiaries are classified into seven categories as of fiscal year 2003, namely, RS1–2, RC1–5. The table is provided in LTCI Business Status Reports produced by the Ministry of Health, Labor, and Welfare (MHLW) every year according to the number of beneficiaries, and includes the condition class RC (RS) by gender, age class, and prefecture (the 3rd table). The Care Benefit Expense Investigation Report is also provided by MHLW and provides each value of transition probability among care classes of beneficiaries who continue to use care services for 1 year from the end of the previous year.

However, with regard to the "RS" bracket, I decided not to distinguish "RS1" and "RS2" and instead used "combined RS" to maintain data continuity throughout the period.

With these data and the data from the entire Japanese population and deaths, we can define an eight-entry column vector of population at year t, L_t=(non-cared, RS, RC 1–5, dead)=$(l_1, l_2, \cdots, l_8 = 0)$. State 8 is an absorption state that denotes "death."

The population vector L_{t+1} of the subsequent year t+1 is renewed using the state transition matrix P, whose components we estimate in this section.

In reality, while mortality rates are assumed to change by gender and age, the matrix P is defined as $P_{(s,x)}$ with suffixes (gender,age)=(s,x).

$$P = \begin{bmatrix} p_{11} & p_{12} & & \cdots & & & p_{17} & q^{(1)} \\ p_{21} & & & & & & & q^{(2)} \\ & & \ddots & & & & & q^{(3)} \\ \vdots & & \cdots & p_{44} & \cdots & & \vdots & q^{(4)} \\ \vdots & & & & \ddots & & & q^{(5)} \\ & & & & & & & q^{(6)} \\ p_{71} & & & \cdots & & & p_{77} & q^{(7)} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

To estimate the transition matrix, we use Table 4 of the Report on LTCI benefit expense investigation, published every year by the MHLW.

Although the tables are on a gender-age aggregate basis, they provide us with transition probabilities between a pair of care classes in a year. In addition, they provide information on entry and exit probabilities from each care class. However, no information is provided on mortality decrements or recovery rates to a non-cared state, so we must estimate both numbers.

The estimation procedures are as follows.

1. According to Table 4 in Inoue (2012), which describes transition movements among states for the 3 years from 2001 to 2003, we can estimate the annual transition matrix P components, including mortality rates (ratios). However, only 3 years of aggregate data were available.

2. To estimate the transition probabilities among care states, we use Table 4 of the Report on LTCI Benefit Expense Investigation published every year by the MHLW, providing each value of the transition probability among care states of beneficiaries who continue to use care services for 1 year from the end of the previous year.

3. The population structure of non-cared above 65-year olds is calculated using public LTCI statistics and those of the whole Japanese population over the period 2001–2011.

4. Transition probability components are calibrated to minimize the differences of theoretical population by gender, age, and care class to the corresponding experience.

Because there was a discontinuity of data before 2008 in the transient period for introducing RS2, we omit all data before 2008. However, after 2008, the transition matrices by care class were rather stable. Thus, we use 4-year average values for each component and the RS combined category instead of distinguishing RS1 and RS2.

$$
\begin{array}{c} \\ RS \\ RC1 \\ RC2 \\ RC3 \\ RC4 \\ RC5 \end{array}
\begin{array}{c}
\begin{array}{cccccc} RS & RC1 & RC2 & RC3 & RC4 & RC5 \end{array} \\
\begin{pmatrix}
84.4 & 9.9 & 4.1 & 1.1 & 0.5 & 0.2 \\
4.9 & 68.6 & 18.4 & 5.6 & 2.0 & 0.6 \\
1.4 & 7.8 & 70.5 & 14.1 & 4.7 & 1.4 \\
0.4 & 2.0 & 8.2 & 69.6 & 15.2 & 4.7 \\
0.2 & 0.7 & 2.2 & 6.7 & 74.7 & 15.5 \\
0.0 & 0.2 & 0.5 & 1.1 & 5.5 & 92.8
\end{pmatrix}
\end{array}
$$

Next, we investigate Inoue et al. (2012) in detail, including Table 3 of population composition by gender, age, group, and care class for the beginning of fiscal year 2001 and Table 4 of transition movements among states for the 3 years 2001–2003.

3.2 Estimation of mortality rates by required care state based on Inoue's experience data

We explain the process for estimating mortality rates (and mortality ratios) by care class and interstate transition probability components between non-cared and RS& RCs. The table below refers to Table 4 of Inoue et al. (2012), and the average ages of the corresponding care class are added to the last columns: early 70s for non-cared, 80–85 for RS& RCs.

		Required care state after 3 years									
		NC	RS	RC1	RC2	RC3	RC4	RC5	death	total	average age
Male year'01	NC	4997	40	107	66	18	29	21	377	5655	71.88
	RS	3	6	12	2	0	2	0	10	35	81.37
	RC1	6	3	40	8	8	8	6	32	111	79.43
	RC2	2	0	5	16	12	8	6	34	83	80.25
	RC3	3	0	0	1	5	2	2	22	35	80.49
	RC4	2	0	0	1	0	9	9	24	45	79.58
	RC5	1	0	0	1	0	0	17	29	48	79.25
	total	5014	49	164	95	43	58	61	528	6012	72.36
Female year'01	NC	5684	88	219	61	35	36	29	217	6369	72.75
	RS	4	17	29	3	3	3	1	11	71	80.04
	RC1	8	10	129	30	19	18	8	45	267	81.22
	RC2	5	1	10	22	24	18	12	27	119	82.60
	RC3	5	0	4	7	16	9	13	21	75	85.09
	RC4	2	0	0	0	3	27	18	29	79	85.51
	RC5	5	0	0	0	2	6	25	36	74	85.31
	total	5713	116	391	123	102	117	106	386	7054	73.71

Table 7: Movements among states(SourceF Inoue et al.(2012))

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We set an annual transition matrix P and an initial state vector L_0, L_0P^3 as a theoretical state vector at the end of fiscal year 2003 and compare these to the corresponding experience data. It is difficult to calibrate all matrix components using these limited constraints, so we adopt the following procedure as the first step to estimate diagonal $P_{ii}(i = 1, 2, \cdots, 8)$ and death $q_j(j = 1, 2, \cdots, 8)$ as well as interstate transition probability components $P_{1j}, P_{i1}, (i, j = 1, 2, \cdots, 7)$.

1. Diagonal components are considered to be staying in the same state for 3 years, so we estimated these as the annual average growth rates of $(diag(L_3)/diag(L_1))^{1/3}$.
2. Mortality decrement probabilities are estimated as theoretical 3-year death rates at $1 - (1 - p)^3$, where p is annual survival probability.
3. Transition probability components between non-cared and care states are estimated based on aggregate male–female data because of scarceness.

The estimated mortality ratios generally slope upward proportional to care class, but these are rather uneven; thus, we smooth these crude ratios using the following graduation technique.

1. Because age structure differs by care class, we graduate age-adjusted mortality ratios against mortality rates of the 21st Life Table.
2. Mortality ratios are defined as number of deaths against number of deaths based on the 21st Life Table.
3. The estimated mortality ratios are graduated using a population-weighted square regression to obtain smoothed values.

Mortality ratios, males and females, crude, and graduated values are well-fitted, as shown in Figures 2 and 3.

	RS	RC1	RC2	RC3	RC4	RC5
RS	*	63	26	7	3	1
RC1	16	*	59	18	6	2
RC2	5	27	*	48	16	5
RC3	1	6	27	*	50	16
RC4	1	3	9	26	*	61
RC5	0	2	6	15	76	*

Table 9: Allocation percentage of one care class to other care classes

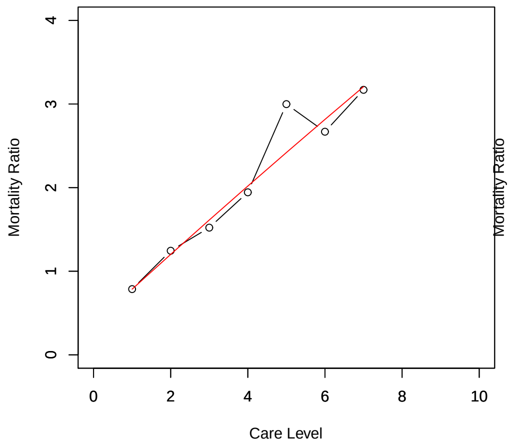

Figure 2: Crude vs. graduated mortality ratios (male)

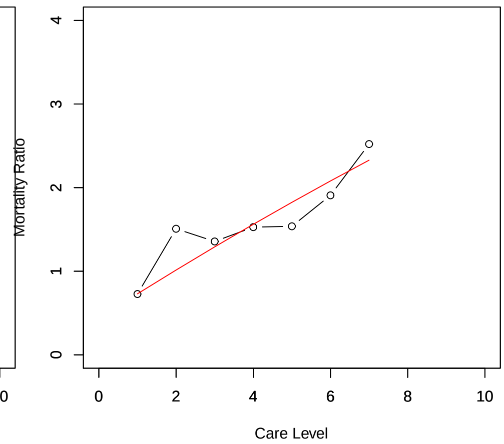

Figure 3: Crude vs. graduated mortality ratios (female)

	NC	RS	RC1	RC2	RC3@	RC4	RC5
male	0.786	1.202	1.613	2.019	2.420	2.816	3.207
female	0.730	1.014	1.292	1.562	1.824	2.080	2.329
aggregate	0.758	1.107	1.452	1.790	2.122	2.448	2.768

Table 8: Mortality ratios by care class

The residual components are assumed to be allocated using the ratios on the following matrix whose sum of rows is 100 according to Table 4 of the Report on LTCI Benefit Expense Investigation.

Finally, under these constraints, we obtained the estimated transition matrix to minimize the Euclidean distance $\|L_3 - L_0 P^3\|$.

[Transition matrix: Male]

$$\begin{bmatrix} 0.960 & 0.0024 & 0.0066 & 0.0040 & 0.0012 & 0.0017 & 0.0014 & 0.023 \\ 0.054 & 0.5555 & 0.1828 & 0.0754 & 0.0203 & 0.0087 & 0.0029 & 0.100 \\ 0.062 & 0.0188 & 0.7116 & 0.0695 & 0.0212 & 0.0071 & 0.0012 & 0.109 \\ 0.023 & 0.0123 & 0.0665 & 0.5777 & 0.1182 & 0.0394 & 0.0098 & 0.153 \\ 0.111 & 0.0018 & 0.0111 & 0.0497 & 0.5228 & 0.0921 & 0.0295 & 0.182 \\ 0.036 & 0.0018 & 0.0053 & 0.0160 & 0.0463 & 0.5848 & 0.1085 & 0.202 \\ 0.010 & 0.0000 & 0.0013 & 0.0038 & 0.0096 & 0.0493 & 0.7075 & 0.218 \\ 0.000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 1.000 \end{bmatrix}$$

[Transition matrix: Female]

$$\begin{bmatrix} 0.963 & 0.0036 & 0.0097 & 0.0058 & 0.0018 & 0.0025 & 0.0020 & 0.012 \\ 0.035 & 0.6210 & 0.1940 & 0.0801 & 0.0216 & 0.0092 & 0.0031 & 0.036 \\ 0.035 & 0.0199 & 0.7847 & 0.0734 & 0.0224 & 0.0075 & 0.0012 & 0.056 \\ 0.030 & 0.0159 & 0.0860 & 0.5697 & 0.1528 & 0.0509 & 0.0127 & 0.081 \\ 0.043 & 0.0024 & 0.0145 & 0.0652 & 0.5975 & 0.1207 & 0.0386 & 0.118 \\ 0.019 & 0.0014 & 0.0042 & 0.0125 & 0.0362 & 0.6992 & 0.0848 & 0.143 \\ 0.033 & 0.0000 & 0.0022 & 0.0066 & 0.0165 & 0.0847 & 0.6965 & 0.161 \\ 0.000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 1.000 \end{bmatrix}$$

These matrices are only applicable to one small city of Japan, so we extend the model and calibrate these results to all LTCI beneficiaries and non-cared population using historical population and mortality data of the entire population from 2001 to 2011.

First, interstate improvement/aggravation probability between care classes are allocated proportional to the coefficients estimated from the Report on LTCI Benefit Expense Investigation. The most important component is the probability of non-cared staying at the same state, which is re-estimated using the whole population data. Mortality rates for males and females are re-estimated on the assumption that mortality ratios change proportionally based on the values of Table 9. Accordingly, we change the components $p_{ij}(i = 1, 2, \cdots, 6)$ other than the mortality rates of each $j - row$ into $p^*ij = \frac{1 - q^{*(j)}}{1 - q^{(j)}}$ to normalize the sum of the row components to 1.

These calibrations are carried out to minimize the differences of theoretical population by gender, age, and care class to the corresponding experience over the period 2001 to 2011.

[Transition matrix: Male]

$$\begin{bmatrix} 0.952 & 0.0061 & 0.0166 & 0.010 & 0.0031 & 0.0044 & 0.0035 & 0.0043 \\ 0.034 & 0.5555 & 0.2496 & 0.103 & 0.0277 & 0.0119 & 0.0040 & 0.0146 \\ 0.016 & 0.0403 & 0.7116 & 0.149 & 0.0454 & 0.0151 & 0.0025 & 0.0206 \\ 0.018 & 0.0189 & 0.1022 & 0.578 & 0.1817 & 0.0606 & 0.0151 & 0.0255 \\ 0.038 & 0.0041 & 0.0245 & 0.110 & 0.5228 & 0.2038 & 0.0652 & 0.0316 \\ 0.015 & 0.0036 & 0.0109 & 0.033 & 0.0942 & 0.5848 & 0.2211 & 0.0374 \\ 0.022 & 0.0000 & 0.0046 & 0.014 & 0.0345 & 0.1773 & 0.7075 & 0.0398 \\ 0.000 & 0.0000 & 0.0000 & 0.000 & 0.0000 & 0.0000 & 0.0000 & 1.0000 \end{bmatrix}$$

[Transition matrix: Female]

$$\begin{bmatrix} 0.946 & 0.0052 & 0.0141 & 0.0085 & 0.0026 & 0.0037 & 0.0030 & 0.017 \\ 0.034 & 0.6210 & 0.1924 & 0.0794 & 0.0214 & 0.0092 & 0.0031 & 0.040 \\ 0.016 & 0.0467 & 0.6276 & 0.1721 & 0.0525 & 0.0175 & 0.0029 & 0.065 \\ 0.018 & 0.0159 & 0.0860 & 0.5697 & 0.1529 & 0.0510 & 0.0127 & 0.094 \\ 0.038 & 0.0024 & 0.0145 & 0.0651 & 0.5975 & 0.1206 & 0.0386 & 0.123 \\ 0.015 & 0.0013 & 0.0039 & 0.0116 & 0.0334 & 0.6992 & 0.0784 & 0.157 \\ 0.022 & 0.0000 & 0.0021 & 0.0064 & 0.0161 & 0.0826 & 0.6965 & 0.174 \\ 0.000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 & 1.000 \end{bmatrix}$$

3.3 Estimation of mortality rates by age

After setting the aggregate mortality ratios by care class, the next step is to decompose them by age. The most recent reliable mortality rates by gender and age are provided from the 21st National Life Table 2010. We obtain the mortality rates by gender, age, and care class and multiply the care-class segmented mortality ratios by those of the 21st National Life Table. That is, we assume that the mortality ratios are determined independent of age despite seeming unrealistic. The next table provides the results of these calculations.

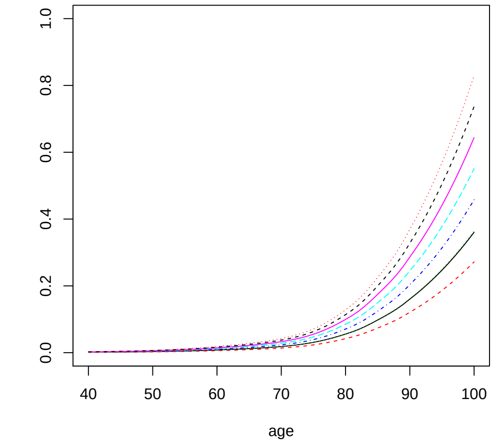

Figure 4: Mortality rates by care class (male)

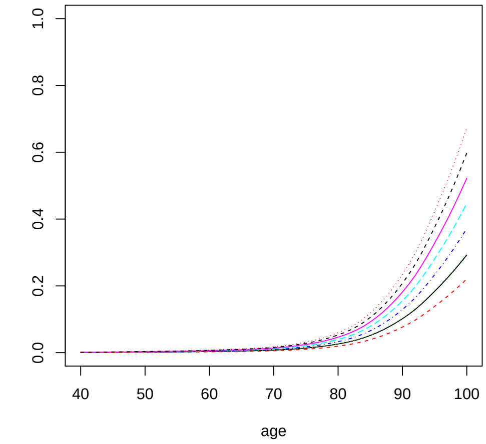

Figure 5: Mortality rates by care class (female)

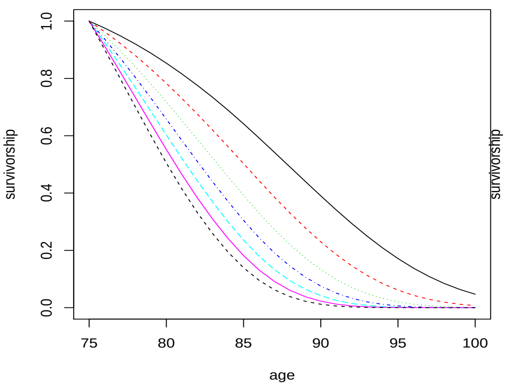

Figure 6: Cohort survival distribution by care class (male, initial age 75)

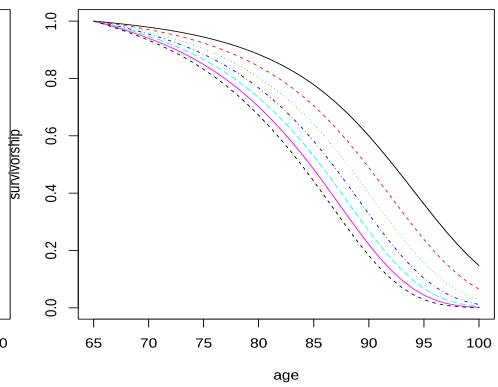

Figure 7: Cohort survival distribution by care class (female, initial age 75)

3.4 Estimation of entries other than mortality decrements

Finally, we decompose the state transition matrix obtained in the preceding subsection into the matrix by gender and age. Because we completed the estimation of the mortality ratios by age, the easiest way to conduct this decomposition is to replace the aggregate mortality $q^{(j)}$ for care class j by the estimated mortality rates $q^{(j)}_{(s,x)}$ by gender and age and proportionally adjust for the remaining components.

Modify mortality rates $q^{(j)}$ into $q^{(j)}_{(s,x)}$ of the state transition matrix P shown in Section 2, and change the components $p_{ij}(i = 1, 2, \cdots, 6)$ other than the mortality rates of $j - row$ into $p^*ij = \dfrac{1 - q^{*(j)}}{1 - q^{(j)}}$ accordingly to normalize the sum of the row components to 1.

Using this method, we can construct $P_{s,x}$. Let X_t be a random variable that indicates the state at time t. If a beneficiary is in state j at $\tau = 0$ and moves to state k at $\tau = t$, we denote the transition probability as $P(X_t = k|X_0 = j)$.

If the vector of the initial state (gender, age, state) = (s, x, j) is written as $e_{(s,j)} = (0, \cdots, \overset{j-th}{1}, \cdots, 0)$, the probability of reaching state k after t years becomes ${}_tp_{(s,x)}(j,k) = P_{(s,x)}(X_t = k|X_0 = j) = e(s,j)_t P_{s,x+\tau}$.

These two figures illustrate that the survival probability curve belonging to each state t years after the initial state are for non-cared males and females aged 65. The large increase around the center indicates that a beneficiary falls in RC states in both figures.

$$\mathring{e}_{s,x}(0,k) = 1/2 + \sum_{t=1}^{\infty} \sum_{k=1}^{7} {}_tp_{(s,x)}(0,k)$$

Moreover, life expectancy can be defined as the average survival time, so we can calculate the survival probability t years after the initial state. The following is the formula for the average life expectancy.

$$\mathring{e}_{s,x}(0,k) = 1/2 + \sum_{t=1}^{\infty} \sum_{k=1}^{7} {}_tp_{(s,x)}(0,k)$$

Average health expectancy means the average period while in the non-cared state, calculated using the following formula.

$$\mathring{e}_{s,x}(0,0) = 1/2 + \sum_{t=1}^{\infty} {}_tp_{(s,x)}(0,0)$$

Finally, we provide the life expectancy table for males and females aged 65, 75, and 85 calculated based on the estimated mortality rates. When RC level becomes serious, mortality rates increase accordingly and life expectancy shortens. On the contrary, for females 65 years of age, RC level has little effect on life expectancy.

	male65	male75	male85	female65	female75	female85
NC	17.68	11.35	6.41	23.42	15.55	8.79
RC1	14.26	8.12	3.91	20.97	12.89	6.48
RC3	13.51	7.26	3.10	20.67	12.40	5.84
RC5	12.86	6.56	2.51	20.18	11.76	5.19

Table 10: Average life expectancy by gender and care class

4 Life annuity features observed in Japanese pension plans

In Japan, the entire pension system both public and private includes the public pension systems for old age, including the Employee's Pension Insurance for private employees, the National Pension Insurance for the self-employed, and Mutual-Aid Pension Insurance for public employees. These systems used to provide the core benefits to guarantee the lifetime protection for the elderly people. Although the income replacement rate of the standard household used to be over 60% in the 1990s, the government gradually decided to reduce its pension benefit level to 50% through the Pension Reform Act in 2004, which adopted the automatic adjustment mechanism (macroeconomic indexation) to the pension benefit amounts.

Moreover, employee pension funds (EPFs), which are the most privatized among all retirement plans and are obligated to include life protection, will be abolished in the near future because of financial deterioration and pension fraud accidents. Furthermore, most other defined benefit corporate pension plans include only limited annuity payment periods, and individual annuity products offered by life insurance companies mostly have the same features. Therefore, retired people are forced to withdraw deposits or savings as retirement lump-sum grants, which is still a widely used retirement benefit practice by companies in Japan.

Providers for lifelong payout annuities are therefore shrinking in scale and number, and the longevity risk of the elderly will emerge in the coming aged society.

5 A primer on ALDA and care annuities

In the United States, the personal pension qualified life annuity contract (QLAC) bill was proposed by the Treasury Department early in 2012 to enact a tax-favored annuity system for the elderly corresponding to the emergence of the longevity risk in the ageing population. The bill opens the purchases of tax-exempt advanced-life delayed annuities that will start accumulating 401(k)-plan or IRA funds by age 85 and over under a fixed limit. An advanced-life delayed annuity (ALDA), proposed by Milevsky (2005), is an instrument for the elderly who outlived their expectations, so this might be similar to "buying auto, home, or health insurance with a large deductible, which is also the optimal strategy when dealing with catastrophic risk," which might be used to help curb the huge longevity risk of the elderly using cheap insurance premiums.

A variant of variable annuity products sold in the U.S. individual annuity market is guaranteed life withdrawal benefit-variable annuity (GLWB-VA), which is a type of ALDA that guarantees life-long fixed payments. Moreover, a new product termed contingent-deferred annuity (CDA) is available, which does not use variable annuities but instead wraps mutual funds as a funding vehicle.

An additional product type, "Impaired annuities" or "enhanced annuities," raise the payout annuity amount with worsening health conditions over time is sold in the United Kingdom. This is a product for healthy persons that seek to prepare for future care needs. On the other hand, "care annuities" are sold to unhealthy persons who already fall under some care class. These are typically divided into three stages according to the required care class.

Policyholders are certified "light" if they have heart disease or require slight support in everyday life. "Mid-level" policyholders have Parkinson's disease or trouble communicating, and "Serious" policyholders experience spasms, require an escort when going out, or demand considerable care support in daily life.

We use these examples as building blocks for redesigning the public pension system.

6 Proposal for re-designing public pension

In this section, based on the results of the preceding section, we create a proposal for redesigning public pension plans to introduce pension benefit increase mechanisms according to care state. If the care state worsens, the life expectancy shortens, and the present value of the annuity drops. In public pension finance, key economic assumptions are a wage growth rate of 1.5% per year and investment return of 2.5% annually, so real return is considered 1%. Therefore, we apply 1% as an assumed interest rate to calculate the present values of life annuities, as follows.

	male65	male75	male85	female65	female75	female85	aggr.65	aggr.75	aggr.85
NC	15.46	10.07	5.63	20.14	13.72	7.82	17.55	11.84	6.89
RC1	12.56	7.18	3.29	18.15	11.42	5.71	15.54	9.56	4.84
RC3	11.89	6.38	2.51	17.88	10.59	5.10	15.13	8.98	4.16
RC5	11.31	5.74	1.95	17.47	10.41	4.49	14.66	8.41	3.60

Table 11: Present values of annuities by gender and age

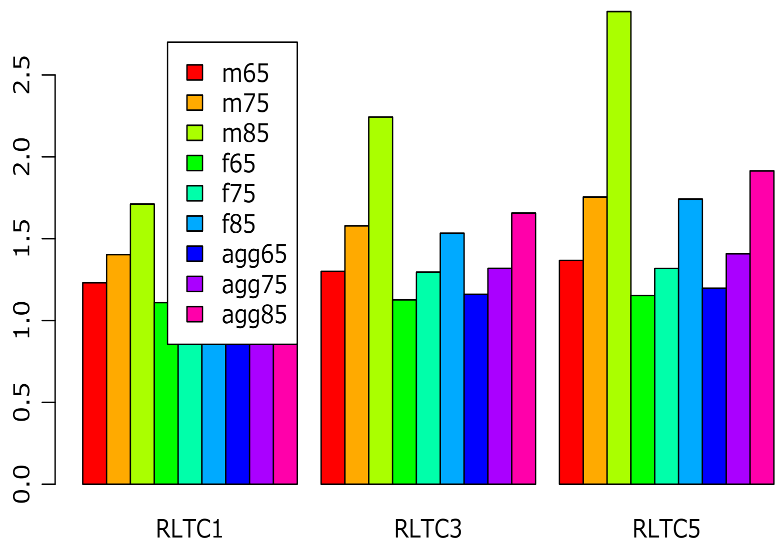

Figure 8: Multiplier of annuity amount (against that of NC)

The pension benefit amount by RC level is standardized using the pension benefit amount for the non-cared set to 1, as the lowest. Six upward curves are seen, from the lowest: females aged 65, 75, and 85 and males aged 65, 75, and 85, which is the highest amount.

Thus, pension benefit increases with care class, gender, and age. If a beneficiary is male, as his care class becomes more serious and his age increases, pension benefit increases. In particular, males aged 85 in RC5 receives the highest amount, 2.2 times that males aged 85 and non-cared.

However, the ratios are not always this high. That is, an RC5 beneficiary receives 1.3x the benefit amount of RC4, that is, ¥30,000 if the typical monthly receipt amount is ¥100,000.

	male65	male75	male85	female65	female75	female85	aggr.65	aggr.75	aggr.85
RC1	1.23	*1.40*	*1.71*	1.11	1.20	*1.37*	1.13	1.24	*1.42*
RC3	*1.30*	*1.58*	*2.24*	1.13	*1.30*	*1.53*	1.16	*1.32*	*1.66*
RC5	*1.37*	*1.75*	*2.89*	1.15	*1.32*	*1.74*	1.20	*1.41*	*1.91*

Table 12: Pension enhancement rates by gender, age, and care class

A male aged 65 entering the public care pension system that is certified as an RC3 beneficiary at age 75, 10 years later, can receive a 1.4x pension increase. If, after an additional 10 years he is certified RC5 (at age 85), his pension increases to 2.2 times that of the male aged 65. However, for females, these increase only 1.2 and 1.5 times, respectively.

Because the purpose is to reduce the premium payment burden for beneficiaries requiring serious LTRC status, it is not necessary to increase pension benefits directly. However, because beneficiaries in serious LTRC have costs in addition to care payments, an appropriate benefit increase is desirable. Moreover, because according to the overall pension design, it is not acceptable to discriminate between pension amounts provided to males and females, valuing the annuity using combined mortality rates of both genders is desirable.

Considering these points, we propose the following changes to the care pension system.

- The pension benefit increase rates should be calculated based on joint-sex mortality rates according to each care class.
- The increased amounts should not be paid directly to beneficiaries, but the money should be pooled to compensate for the increased personal LTCI burden.
- If some money remains, it can be used to increase the pension benefit.

Under this reform, because the mortality rates of the non-cared are lower than before, actuarially fair premiums increase. However, in Japan's public pension, the premium has already been fixed and there exists an automatic-adjustment mechanism of pension benefits, that is, macroeconomic indexation. Because the population reduction of 0.9% is already included in macroeconomic indexation, an additional slight burden on this factor might help curb the longevity risks.

To put this proposal into effect, it is necessary to review the present average and benefit limit of the LTCI and to consider the proper balance with the pension system. A discussion should also be conducted on the average proper annuity increase rate according to care level required.

7 Conclusion

In this paper, we estimated the mortality ratio by care class using beneficiary data of public LTCI and proposed a redesign of the public pension benefit structure by introducing the "care pension," which provides LTCI beneficiaries a pension increase to compensate for LTCI self-payment according to their care class.

Although the costs and expenses concerning long-term care services are expected to substantially increase, certain financial support is required to provide hospitable services for beneficiaries who require serious care and for which these increased amounts of pension benefits are available. A desirable solution that concentrates and distributes social security resources efficiently is thus required.

For the future research, we need more detailed data on the LTCI. Although the mortality rates by care class were estimated indirectly, we would prefer to use statistics concerning the beneficiary's entry and exit into the LTCI group. Moreover, additional detailed information about LTCI beneficiary attributes (e.g., job, earnings, family structure) will provide deeper insights into the system.

Social security reform should aim to lengthen the so-called "healthy life expectancy," employing the elderly so they pay more insurance premiums and not receive so many benefits. To show this, we create a "healthy life expectancy" table based on the "life expectancy" table at the end of Section 3.

The following tables compare both life expectancy and healthy life expectancy. The difference implies the period that people remain at certain required cared state. For example, the difference of life expectancy and healthy life expectancy is large (1.66 for females aged 65, and 1.22 for male aged 65).

	male65	male75	male 85	female65	female75	female85
life expectancy	17.68	11.35	6.41	23.42	15.55	8.79
health expectancy	13.43	9.45	5.74	17.20	12.48	7.68
difference	4.35	1.92	0.65	6.22	3.07	1.11

Table 13: Average life expectancy and average healthy life expectancy

This analysis clarifies that in order to shorten a beneficiary's serious care time, it is critical to help him or her recover at an early stage and ensure that he or she does not enter an RC state in a younger phase. Moreover, sufficient countermeasures for females are needed more than for males, because females stay in RC states longer. It is believed that countermeasures in the early stages are also appropriate from a cost-benefit viewpoint. Further medical and physiological investigation of this issue is required.

Advanced elderly with medical insurance may have more serious problems than those with LTCI. Although the medical payments of those aged 75 and over exceeds those of the younger generation by 5 times, reconciling elderly medical expenses with the public pension system may be recommended. More research is needed to investigate the relationship of mortality rates with required care class and illnesses and further refine social security efficiency.

Finally, we consider the roles of public and private pension. The income replacement rate should ideally stay at 60% or over through public pension benefits alone as in many advanced countries, although, as we pointed out, it is set to drop to 50% in Japan.

To close this gap, circulation of ALDAs is critical, whether public or private. Tax-favored personal annuities for longevity risk should also be discussed, as proposed in the United States.

We should further consider the type of pension structure that is best for the coming ultra-ageing society.

References

[1] Moshe A. Milevsky(2005), "Real longevity insurance with a deductible: Introduction to advanced life-delayed annuities (ALDA)",NAAJ Vol. 9, No. 4, 109-122.

[2] Yosuke Fujisawa and Johnny Siu-Hang Li(2012), "The impact of the automatic balancing mechanism for the public pension in Japan for the extreme elderly",NAAJ Vol. 16, No.2, 207-239.

[3] Tachika Eiji and Kikuchi Jun (2006), "What's wrong with long-term care insurance?", Financial Review March 2006, Ministry of Finance Policy Research Institute.

[4] Kazuko Mitoku, Masako Morito, Sanae Tomita, Takako Sinpou, Mitsushiro Nagao, and Takanori Ogawa (2011), "Relationship between the level of care, degree of bedriddenness, and severity of dementia and mortality rates of elderly required long-term care in a hilly and mountainous area in city A", Kawasaki Medical Welfare Journal Vol. 20, No. 2, 383-389.

[5] Naoko Inoue (2012), "The chronological trend of the bedridden status and preventative factors and cumulative survival rate during three years in the Japanese urban elderly dwellers", Bulletin of Social Medicine, Vol.30, No. 1.

[6] Hidemi Kijima, “A study on levels of care changes for individuals required long-term care at home - With reference to the level of care service use and changes in the level of care needs-”.

[7] Ministry of Health, Labour, and Welfare. http://www.mhlw.go.jp/

[8] National Institute of Population and Social Security Research. http://www.ipss.go.jp/