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Long-term care insurance effects on Japan's regional economy: an approach linking theoretical with empirical analysis

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Long-term care insurance effects on Japan's regional economy: an approach linking theoretical with empirical analysis[†]

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Abstract

Long-term care insurance plays an important role in Japan, where dual problems of an aging population and low birthrate have continued. Such insurance affects the macro-economy through many mechanisms, with both negative and positive influences. Although increased taxes and insurance premiums from long-term care decrease consumption, decreasing precautionary saving eventually increases consumption because of decreased risks of long-term care and mitigation of self-payment for people receiving long-term care services. Furthermore, effects on household consumption by the aging population and low birthrate are expected to differ among regional economies. This study, particularly addressing insurance effects on household consumption and the regional economy, develops a theoretical model for household consumption and assesses numerical examples of macroeconomic effects using parameters that are consistent with data for Japan. Furthermore, using a multi-regional input–output (MRIO) table at the prefectural level in Japan, we examine long-term care insurance effects on household consumption and economic ripple effects occurring regionally and nationally. The results reveal differences in insurance effects by region and by household generation. Gross Domestic Product (GDP), representing total economic activity, rises. Gross Regional Product (GRP) can also be pulled up. However, because of a difference in the degrees of increase in GRP in the respective regions, GRP inequality can be magnified. Specifically considering these results, we assess relations between regional economic disparities and improvements in long-term care insurance.

Keywords: Elderly care subsidy, Household consumption, Multi-regional Input–Output (MRIO) table, Precautionary saving

JEL Classification: R15, E21

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I Introduction

Our study examines how a subsidy for long-term care insurance affects aggregate consumption, gross domestic product, and other economic indicators. Japan's long-term care insurance was launched in April 2000: older people who require care can use the care service by paying 10% of the care service fee. The rate of 10% is applied to standard households. Actually, the rate benefit of 10–30% depends on the household income level. This insurance is specifically intended for the aging population and older people who use the long-term care services, whose numbers are increasing continuously.[1]

Long-term care insurance reduces precautionary saving,[2] which raises consumption. By virtue of long-term care insurance, the future cost of long-term care can be small. People need not save for long-term care. Many will never need long-term care. This risk pooling effect of insurance is considered in work by Omori et al. (1998), Smith and Witter (2004), and others.

Nevertheless, long-term care has a negative effect on consumption because the long-term care premium reduces household disposable income. A decrease in household income reduces consumption. Moreover, a decrease in household income and precautionary saving reduce the aggregate investment and the capital stock decreases. Subsequently, the aggregate production declines; GDP decreases. This negative effect is derived by Tabata (2005), Mizushima (2009), and others.

This study was conducted to examine how a subsidy for long-term care affects the regional economy. Using a model with inter-regional trade and differences of industrial structure, this study examines how the subsidy affects consumption in regions. Specifically, after developing a household optimization model with long-term care and overlapping generations for the first stage, we empirically examine how the subsidy affects aggregate consumption using the multi-regional input–output (MRIO) table compiled by Hasegawa et al. (2015). Based on results obtained from this study, we conclude that the subsidy for long-term care plays an important role in an aging population by promoting the regional economy and by mitigating income inequality.

Yasuoka (2016) demonstrates that the subsidy for long-term care affects aggregate consumption and utility, among other factors. Nevertheless, no report of the relevant literature describes a study examining income inequality between regions in terms of the subsidy for long-term care.

The results obtained through this study are presented as follows. A decrease in the self-care fee (from 20% to 10%) with an increase in the premium of long-term care insurance raises the aggregate consumption of young and adult generations. Even if the premium reduces consumption, a decrease in precautionary saving can raise consumption. However, the aggregate consumption by old people is decreased by an increase in the long-term care premium. Nevertheless, one must consider inequality within regions in terms of GDP as the total economic activity in the country increases. Because of a decrease in self-care fees that is expected to occur along with the increase in premium of long-term care insurance, the inequality of Gross Regional Product (GRP) within regions is magnified. Therefore, a redistributive policy to reduce inequality must be considered.

The remainder of this paper is presented as follows. Section II explains the MRIO model to examine the subsidy for long-term care. Based on the overlapping-generations model, Section III develops a theoretical model with household optimization. Section IV presents derivation of the theoretical analysis results with numerical examples and input–output analysis. In the final section, we conclude this paper.

II Input–output Model for Long-term Care Insurance Analysis

1 Multi-regional Input–output Table at the Japanese Prefectural Level

Our study was conducted using an MRIO table to identify the comprehensive effects on regions and industries of long-term care insurance.[3] Regional input–output tables are classifiable into intra-regional, inter-regional, and MRIO tables. Whereas intra-regional input–output tables endogenously identify transactions within a single region and inter-regional transactions do so exogenously, inter-regional and MRIO tables endogenously consider both transactions and clarify the interrelations between regions. Therefore, using MRIO tables is desirable for the comprehensive identification of economic repercussions generated inside and outside a region.

In Japan, the Ministry of Economy, Trade and Industry (METI) officially compiles an inter-regional input–output table for Japan, which is divided for the purpose into nine regions. However, some difficulties exist in application of this table to our analysis. A district in the table is simply a large single area with diversity in terms of population and economy. It does not coincide with the regional segment that a single local government manages. Therefore, policy implications cannot be derived from using the METI table.

For analyses at the prefectural level, we use an MRIO table that includes all prefectures in Japan. Although the MRIO table is not officially compiled by the administrative office, some earlier studies, such as those by Ishikawa and Miyagi (2004), Hagiwara (2011), and Hasegawa et al. (2015), have included attempts to compile the tables. This study uses the table compiled by Hasegawa et al. (2015), which is freely available online at the *Journal of Economic Structures* website.

Table 1 Industrial Classification in the MRIO Table

(1)	Agriculture, forestry, and fisheries	(21)	Medicaments	(41)	Office machines and machinery for service industries	(61)	Gas, steam, and hot water supply
(2)	Metal ores	(22)	Petroleum refinery products	(42)	Household electric and electronic appliances	(62)	Water supply and other sanitary services
(3)	Nonmetal ores	(23)	Coal products	(43)	Electronic computing equipment and accessory equipment	(63)	Trade
(4)	Coal, crude petroleum, and natural gas	(24)	Plastic products	(44)	Communication equipment	(64)	Financial service and insurance
(5)	Food and tobacco	(25)	Rubber products	(45)	Applied electronic equipment and electric measuring instruments	(65)	Real estate agencies, managers, and rent
(6)	Drinks	(26)	Glass and glass products	(46)	Semiconductor devices and integrated circuits	(66)	House rent (imputed house rent)
(7)	Fabric	(27)	Cement and cement products	(47)	Electronic components	(67)	Transport
(8)	Apparel and other ready-made textile products	(28)	Pottery, china, and earthenware	(48)	Industrial heavy electrical equipment	(68)	Telecommunication
(9)	Timber and wooden products	(29)	Miscellaneous ceramic, stone, and clay products	(49)	Other electrical equipment	(69)	Broadcasting
(10)	Wooden furniture and accessories	(30)	Pig iron and crude steel	(50)	Motor vehicles	(70)	Information service
(11)	Pulp and paper	(31)	Steel	(51)	Other motor vehicles	(71)	Internet services
(12)	Converted paper products	(32)	Cast and forged materials	(52)	Steel ships and repair	(72)	Video and data entry services
(13)	Publishing and printing	(33)	Other iron or steel products	(53)	Other transportation equipment and repair	(73)	Advertising services
(14)	Chemical fertilizer	(34)	Nonferrous metals	(54)	Precision machinery	(74)	Public administration
(15)	Industrial inorganic chemicals	(35)	Nonferrous metal products	(55)	Miscellaneous manufacturing products	(75)	Education and research institute
(16)	Petroleum chemical basic products	(36)	Metal products for construction and architecture	(56)	Reuse and recycling	(76)	Medical service, health, social security, and nursing care
(17)	Organic chemical products	(37)	Other metal products	(57)	Construction and repair of construction	(77)	Goods renting/leasing
(18)	Resin	(38)	General industrial machinery	(58)	Public construction	(78)	Other business services
(19)	Chemical fiber	(39)	Special industrial machinery	(59)	Other civil engineering and construction	(79)	Personal service
(20)	Final chemical products	(40)	Other general machines and parts	(60)	Electric power	(80)	Other

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Intermediate input</td><td colspan="3">Final demand</td><td rowspan="2">Export</td><td rowspan="2">Production value
(Total output)</td></tr>
<tr><td>Hokkaido (1)</td><td>••••••••</td><td>Okinawa (47)</td><td>Hokkaido (1)</td><td>••••••••</td><td>Okinawa (47)</td></tr>
<tr><td>Intermediate input</td><td>Hokkaido (1)
••••••••
Okinawa (47)</td><td colspan="3">A</td><td colspan="3">f</td><td>e</td><td>x</td></tr>
<tr><td colspan="2">Import</td><td colspan="3">m</td><td colspan="3">m</td><td></td><td></td></tr>
<tr><td colspan="2">Value added</td><td colspan="3">v</td><td colspan="3"></td><td></td><td></td></tr>
<tr><td colspan="2">Production value
(Total input)</td><td colspan="3">x</td><td colspan="3"></td><td></td><td></td></tr>
</table>

Fig. 1 MRIO Table structure.

Data used in the MRIO table are those for 2005. The MRIO table includes data of 47 prefectures in Japan and 80 industrial sectors. The industrial classification is shown in Table 1. Figure 1 depicts the structure of the table used for our study. As presented in Fig. 1, transactions in the intermediate and final demand sectors are identifiable at the prefectural level. Imports and exports between prefectures are dealt with endogenously. The MRIO table includes imports (**m**) as a lump sum along the column direction independently from the intermediate input (**A**) and the final demand (**f**).

The balance equations of the MRIO model are presented as Eq. (1). Also, **X**, **A**, **f**, and **e** are the respective vectors of production, matrix of input coefficient, vector of final demand, and vector of exports. Eq. (1) represents the balance equation of production values to the row direction: Eq. (1) can be rewritten as Eq. (2).

$$\underbrace{\begin{bmatrix}\mathbf{x_1}\\\mathbf{x_2}\\\vdots\\\mathbf{x_R}\end{bmatrix}}_{\mathbf{x}}=\underbrace{\begin{bmatrix}\mathbf{A_{11}}&\mathbf{A_{12}}&\cdots&\mathbf{A_{1R}}\\\mathbf{A_{21}}&\mathbf{A_{22}}&\cdots&\mathbf{A_{2R}}\\\vdots&\vdots&\ddots&\vdots\\\mathbf{A_{R1}}&\mathbf{A_{R2}}&\cdots&\mathbf{A_{RR}}\end{bmatrix}}_{\mathbf{A}}\underbrace{\begin{bmatrix}\mathbf{x_1}\\\mathbf{x_2}\\\vdots\\\mathbf{x_R}\end{bmatrix}}_{\mathbf{x}}+\underbrace{\begin{bmatrix}\mathbf{f_{11}}\\\mathbf{f_{21}}\\\vdots\\\mathbf{f_{R1}}\end{bmatrix}}_{\mathbf{f_1}}+\cdots+\underbrace{\begin{bmatrix}\mathbf{f_{1R}}\\\mathbf{f_{2R}}\\\vdots\\\mathbf{f_{RR}}\end{bmatrix}}_{\mathbf{f_R}}+\underbrace{\begin{bmatrix}\mathbf{e_1}\\\mathbf{e_2}\\\vdots\\\mathbf{e_R}\end{bmatrix}}_{\mathbf{e}} \tag{1}$$

$$\Leftrightarrow \mathbf{x}=(\mathbf{I}-\mathbf{A})^{-1}(\mathbf{f_1}+\cdots+\mathbf{f_R}+\mathbf{e}) \tag{2}$$

In that equation, $(\mathbf{I}-\mathbf{A})^{-1}$ represents the Leontief inverse matrix. Using it, the production value induced by final demand and exports can be determined. As presented in Fig. 1, the MRIO table excludes imports (**m**) in the intermediate and final demand sectors by deducting them from the column direction as a lump sum. Therefore, the import vector is originally excluded from Eqs. (1) and (2).

2 Construction of the Inter-regional Transaction Matrix of Private Consumption for Each Age Level

Effects of long-term care insurance on consumption are expected to differ by age. Therefore, one must examine the effects of the respective age levels and divide private consumption by the respective age levels.[4] The process details are presented in Table 2.

We explain the process of (1) in Table 2. Based on *Kakei Chousa Nenpou* (Statistics Japan, 2006a) in 2005, we reallocate the consumption expenditure of each item (JPY per household, monthly) into 80 sectors in the MRIO table. Using information in the input–output table at the national level, we exchange the consumption expenditure shown by the consumer price with that shown by the producer price. One can obtain the annual national consumption expenditure per household of each age level by multiplying this 12 times.[5]

Table 2 Process used to Divide Consumption Expenditure by Age Level

Process		Contents
(1)	Derivation of annual consumption expenditure per household of each age level at the national level	Considering the differences between *Kakei Chousa Nenpou* (Statistics Japan, 2006a) and the input–output tables related to the concept, definition, and range in classifications, we reallocate the consumption expenditure of each item into sectors in the MRIO table.
(2)	Derivation of annual consumption expenditure at the prefectural and age levels	This is obtainable by calculating (national consumption expenditure per household of each age level) × (number of households of each age level in each prefecture). The age level of the household is based on the head of household (seven classifications: less than 29, 30–39, 40–49, 50–59, 60–64, 65–69, and more than 70 years old).
(3)	Allocation of annual consumption expenditure of each age level in each prefecture	Using inter-regional coefficients based on private consumption vectors in the MRIO table, we allocate the consumption expenditure into self-support and domestic imports from other regions.
(4)	Adjustment of private consumption in the MRIO table	We use the RAS method to make the divided consumption by age levels consistent with the values in the MRIO table. For the RAS calculation, we use the divided consumption by age level as an initial matrix and total consumption for regions and industries as control totals.

III The Model

1 Model Setting

In this section, based on Hasegawa and Yasuoka (2019), we develop a model for long-term care insurance. This economy has agents of two types: households and the government.[6]

(1) Households

Individuals live in three periods: the first period (youth, 15–39 years of age), the second period (adulthood, 40–64 years of age), and the third period (old age, 65–89 years of age). In the adult and old periods, individuals must pay a premium for long-term care insurance.[7]

The budget constraint in the young period is shown as

$$c_1 = (1-\varepsilon)w_1 - s_1 \ . \tag{3}$$

In that equation, the following variables are used: w_1 represents the wage rate in youth; s_1 denotes saving during youth; ε stands for the contribution rate for pension; and c_1 signifies consumption during youth. Labor supply is provided elastically.

The budget constraint in adulthood is

$$c_2 = (1-\tau-\varepsilon)w_2 + (1+r)s_1 - s_2, \tag{4}$$

Therein, w_2 stands for wage rate in adulthood, r denotes interest rate for s_1 and s_2 saving in adulthood, τ represents the premium rate for long-term insurance, and c_2 signifies consumption during adulthood.

In old age, households face two health conditions: good and bad.
They do not need long-term care if they are in good health. Then, the budget constraint is

$$c_3^g = z + (1+r)s_2 - T. \tag{5}$$

In that equation, z represents the pension benefit, T denotes the premium for long-term care insurance, and c_3^g signifies consumption during old age with good health.

The budget constraint in old age with bad health is

$$c_3^b = z + (1+r)s_2 - T - (1-\theta)\sigma. \tag{6}$$

That equation uses θ as the subsidy rate for long-term care, σ to represent long-term care cost, and c_3^b to denote consumption in old age with bad health. Our study assumes that individuals cannot know the status of their health condition *ex ante*. In old age, the health condition is given. Therefore, uncertainty exists with respect to long-term care.

We assume the following expected log utility function as

$$u_t = lnc_1 + lnc_2 + plnc_3^g + (1-p)lnc_3^b. \tag{7}$$

In that equation, p denotes the probability of long-term care; $1-p$ represents the probability of no long-term care ($0 < p < 1$). Individuals allocate s_1 and s_2 to maximize their utility Eq. (7) is subject to budget constraint Eqs. (3)–(6). Also, s_1 and s_2 are such that the following equations hold.

$$\frac{1}{(1-\varepsilon)w_1 - s_1} = \frac{(1+r)}{(1-\tau-\varepsilon)w_2 + (1+r)s_1 - s_2} \tag{8}$$

$$\frac{1}{(1-\tau-\varepsilon)w_2 + (1+r)s_1 - s_2} = \frac{p(1+r)}{z+(1+r)s_2 - T} + \frac{(1-p)(1+r)}{z+(1+r)s_2 - T - (1-\theta)\sigma} \tag{9}$$

With s_1 and s_2, we obtain $c_1, c_2, c_3^g,$ and c_3^b from Eqs. (3)–(6).

(2) Government

The government collects premiums from adults and old people and provides subsidies for long-term care. Considering n as the population ratio between the adult and old generations, the budget constraint of long-term care insurance with balanced budget is given as

$$(1-p)\theta\sigma = n\tau w_2 + T. \tag{10}$$

In addition, the government provides pension benefits financed by the revenue of premium and the fund. The balanced budget restriction does not hold. Being different from Hasegawa and Yasuoka (2019), the long-term care insurance is assumed for these analyses to be managed by the local government, which is consistent with the real economy. Therefore, the insurance premium T differs among prefectures because of different long-term care costs $(1-p)\theta\sigma$.

2 Long-term Care Insurance and Saving

Based on Eq. (8), we examine how an increase in τ affects saving. The right-hand side of Eq. (8) can be raised by an increase in τ. This expression shows an increase in marginal utility of c_2; then the individuals raise s_1. In other words, an increase in the premium fee of the young adult generation raises saving during the young period.

Considering Eqs. (9) and (10), we obtain the following equation.

$$\frac{1}{(1-\tau-\varepsilon)w_2+(1+r)s_1-s_2}=\frac{p(1+r)}{z+(1+r)s_2-T}+\frac{(1-p)(1+r)}{z+(1+r)s_2-T-\sigma+\dfrac{n\tau w_2+T}{(1-p)}} \qquad (11)$$

The left-hand side of Eq. (11) represents the marginal utility of c_2. The right-hand side shows the marginal utility of c_3^g and c_3^b. An increase of τ raises the marginal utility of c_2; individuals reduce s_2.

With an increase in T, s_2 increases if the marginal effect of c_3^g (shown as the first term in the right-hand side of Eq. (11)) is greater than that of c_3^b (shown as the second term in the right-hand side of Eq. (11)). Otherwise, s_2 reduces.

In the following subsection, we check the result obtained using the theoretical analysis using numerical examples.

3 Numerical Examples

Based on work reported by Yasuoka (2016, 2017) and by Hasegawa and Yasuoka (2019), we set the parameters for the numerical examples.[8] As shown by the Cabinet Office, Japan (2018), the ratio of people requiring elderly care among the older population was 17.9% at the end of 2015. However, our analysis considers the case in which the local government manages long-term care insurance and considers the share of elderly care people to the older population in each prefecture. From data of the Ministry of Health, Labour and Welfare, Japan (2017a), we can then obtain the share of elderly care people among the older population in the respective prefectures. The average is given as 17.9%.

Recently, the long-term interest rate (10 years) in Japan is about 1% per year (Cabinet Office, Japan, 2017). Youth and adulthood periods are 25 years, respectively. Therefore, we set $1+r$=1.282432.

We set w_1=233.565625 and w_2=307.4125, as estimated based on the Ministry of Health, Labour and Welfare (2016) and Statistics Japan (2018). The age level of wage for non-regular employment was 37.5% in 2015 in the estimation.

The average long-term care cost is about 191,300 JPY per month, as shown by data for April 2015 (Ministry of Health, Labour and Welfare, 2017b). Then, considering the annual amount, we set $\sigma=278.76$

as the average.

The pension contribution rate is 18.3%. Half of this 18.3% must be paid by the employee. Then, we set ε =0.0915.

Based on data reported by the Japan Pension Service (2016), the pension benefit is about 102,798 JPY per month. By considering the annual amount, we set z =123.3576.

The premiums of long-term care insurance for older people and adults are set as

$$T = \frac{0.22}{0.5}\theta\sigma(1-p), \tag{11}$$

$$\tau = \frac{0.28}{0.5}\frac{\theta\sigma(1-p)}{\frac{N_y}{N_o}}\frac{1}{w_2}, \tag{12}$$

where $n = \frac{N_y}{N_o}$ and N_y and N_o respectively denote the population sizes of the adult generation and the old generation.

According to the Ministry of Health, Labour and Welfare (2017a), older people and adult populations were, respectively, 33.82 million and 42.2 million. In the fiscal system for long-term care insurance, the respective shares of tax and premium revenue of each were about half of the total fiscal scale. Regarding premium revenue, 22% is paid by older people and 28% by adults. The tax revenue is proportionally allocated for adults and older people based on the share of the premium revenue.

Table 3 presents the parameter setting.

Table 3 Parameter Setting

$1 + r = 1.22019$
$w_1 = 233.565625$
$w_2 = 307.4125$
$p = 0.821$ (Average in Japan) (Max $p = 0.857$, Min. $p = 0.778$)
$\sigma = 278.76$ (Average in Japan) (Max $\sigma = 307.56$, Min. $\sigma = 265.8$)
$\varepsilon = 0.0915$
$z = 123.3576$

IV Analysis Results

1 Results of a numerical example in a theoretical model

First, we examine the results of a numerical example in a theoretical model of household behavior as set in section III.

As the case of the change of benefit rate of long-term care insurance, we analyze numerical examples of the case of an increase in θ from 0.8 to 0.9 and the case of a decrease in θ from 0.8 to 0.7. The benefit range in long-term care insurance in Japan is 10%–30%. Subsequently, we examine change in the effects of the benefit rate of 10%–30%. Table 4 presents the results.

An increase in the benefit rate of long-term care insurance by which θ increases from 0.8 to 0.9 raises c_3^b by 10.12%. We can consider that households can cut the payment for long-term care cost and that the household can afford to increase consumption. However, c_3^g decreases by 2.24%. The reason is explainable as follows. An increase in the tax burden and insurance premium reduces household disposable income; thereby, consumption decreases. Furthermore, an increase in the benefit rate of long-term care insurance reduces household precautionary saving, which reduces consumption in the old period.

Each of c_1 and c_2 increases slightly by 0.19%. An increase in the benefit rate of long-term care insurance reduces precautionary saving. Young and adult people can raise consumption because of a decrease in the necessity for saving.

Results of the case of a decrease in the benefit rate of long-term care insurance show the inverse results of the case of an increase in the benefit rate. An increase (a decrease) in the benefit rate raises (reduces) the utility. This result corresponds to the result by which an increase (a decrease) in the benefit rate raises (reduces) the aggregate consumption, including every generation's consumption.

Table 4 Change rate of benefit rate, utility and consumption in the country

(%)

Benefit Rate	Utility	Consumption			
				Old	
(θ)	(u)	Young (c_1)	Adult (c_2)	(No Elderly Care) (c^g_3)	(Elderly Care) (c^b_3)
0.7	-0.03010	-0.36067	-0.36071	2.56190	-9.70755
0.8	0	0	0	0	0
0.9	0.01595	0.19017	0.19007	-2.23589	10.11788

2 Ripple effect of an increase in the benefit rate of long-term care insurance

Based on Table 4, we check the ripple effect of an increase in benefit rate of long-term care insurance. Concretely, we examine the case of an increase in the benefit rate from 80% to 90%: we use the rate of change of each generation's consumption by which the benefit rate changes from 80% to 90% (the rates of change of c_1, c_2, c_3^g and c_3^b are shown respectively as 0.19%, 0.19%, -2.24%, 10.12%) to derive the induced production value and induced gross added value with the inter-prefectural input–output table.

As a detailed explanation, we assume that the aggregate consumption of each generation in each prefecture is changed by the change of each generation's consumption. We obtain the induced production value by which the change among of aggregate value is multiplied by the vector of private consumption of each age level. Moreover, we obtain the induced aggregate added value with the calculated induced production value multiplied by the coefficient of each prefecture and each industry derived using the inter-prefectural input–output table.

Therefore, our input–output analysis considers not an increase in the demand for elderly care by an increase in benefit rate of long-term care insurance but the effects of consumption expenditures of other kinds. Then we assume that the rate of change of each generation's consumption is the same among prefectures, along with the inter-regional trade ratio and the ratio of each kind of consumption. Although these assumptions should be considered, our manuscript can hold the effect completely, not only on the elderly care service sector, but also on other kinds of industry.

Our paper presents consideration of a three-period overlapping generations model with its respective young, medium, and old periods. In considering input–output analysis, we consider households headed by people who are ≤29 or 30–39 years old as those of the young period, households headed by people who are 40–49, 50–59, or 60–64 years old as those of the adult period, and households headed by people who are 65–69 or ≥70 years old as those of the old period.

Table 5 Change of induced production value and induced aggregate added value

Values induced in each region

Values each region generates

(million yen)

			1 Hokkaido	2 Aomori	3 Iwate	4 Miyagi	…	47 Okinawa	Production-based total
1	Hokkaido	(A)	16432	72	73	172	…	78	24418
		(B)	10357	35	35	88		39	14279
2	Aomori	(A)	65	2986	15	37	…	18	4736
		(B)	33	1963	8	19		9	2829
3	Iwate	(A)	73	17	3141	39	…	20	5109
		(B)	35	8	2123	20		9	3065
4	Miyagi	(A)	166	38	38	6299	…	38	10358
		(B)	80	18	18	4082		18	6023
⋮			⋮	⋮	⋮	⋮	⋱	⋮	⋮
47	Okinawa	(A)	30	7	7	20	…	4206	5028
		(B)	15	4	3	10		2560	2974
Consumption-based total		(A)	25584	5085	5266	10883	…	6479	587831
		(B)	14615	2940	3103	6298		3602	337770

Note) (A) and (B) denote production value and gross value added, respectively, induced by increasing subsidy rate for elderly care.

Table 6 Change of GDP and aggregate consumption in household sector in the country

(million yen)

	Young Households (Less than 39 years old)	Adult Households (40-64 years old)	Old Households (More than 65 years old): Elderly Care Households	Old Households (More than 65 years old): No Elderly Care Households	Old Households (More than 65 years old): Total Households	Total
GDP	106410	241669	988314	-998623	-10310	337770
Private Consumption	123109	279644	1147016	-1158981	-11965	390788

By virtue of the induced production value calculated using an inter-prefectural input–output table in our analyses, we can check the trade relation not only for each industry but also for each prefecture. Table 5 shows the calculated induced production value and the induced gross added value shown as the one sector of unit of a prefecture by summing up each industry sector. However, because showing all prefectures is complicated, we present part of the result. Regarding an increase in the long-term care insurance benefit rate, the induced value of each region brought about by the consumption in a region is shown by the column direction. The induced value of a region brought about by the consumption in each region is shown by the line direction in Table 5. Table 5 presents these effects on the consumption as the form of a matrix. Therefore, the sum of the column and line shows the total induced value brought about by a region (total value based on consumption) and the total induced value in a region (total value based on production).

Next, we examine the results in terms of the induced value that is based on production, as shown by the sum of line in Table 5. The sum of induced production values shows the induced value in each prefecture brought about by a uniform increase in the benefit rate of long-term care insurance in a country. The gross induced added value shows the change of Gross Regional Product (GRP). We consider the total of change of GRP as the change of Gross Domestic Product (GDP).

Table 6 presents the change of household consumption and GDP in a country brought about by an increase in the benefit rate of long-term care insurance. Regarding GDP, thanks to an increase in the consumption of young households and medium households, GDP is pulled up by 106.4 billion JPY and 241.7 billion JPY. Regarding effects of older households, elderly people who obtain long-term care benefits raise the consumption. However, elderly people who do not obtain long-term care insurance reduce the consumption. These two total effects reduce the consumption. Then GDP is reduced by 10.3 billion JPY. As a total effect, GDP and household consumption increase respectively by 33.78 billion JPY and 39.08 billion JPY. An increase in GDP is less than an increase in household consumption because the household consumption includes import goods. The increase in GDP attributable to domestic production ripple effects brought about by the domestic product is less than the resultant increase in household consumption.

Table 7 presents the induced added value based on product value in Table 5 as a rate of increase of the Gross Regional Product (GRP). An increase rate by each household (young household, adult household and old household) is shown in addition to an increase rate by effects of every household. Here, GRP is derived as total of gross added value of each prefecture in the inter-prefectural input output table.

Considering the effects of all households, there exists a 1.5615 times difference between prefectures from Yamanashi Pref., which shows the lowest increase rate of 0.0520%, to Okinawa Pref., which shows the highest increase rate of 0.0916%. However, considering the rate of increase of each generation's households, a 1.9726 times difference and a 1.9103 times difference is found for young households and old households. Then it is apparent that the effects of an increase in Gross Regional Product brought about by these households differ among prefectures.

Table 7 Rate of GRP change brought about by changed household consumption

(100 million yen) (%)

		GRP	Young Households	Adult Households	Old Households			Total Households
					Elderly Care Households	No Elderly Care Households	total	
1	Hokkaido	190626	0.0235	0.0537	0.2254	-0.2276	-0.0023	0.0749
2	Aomori	43927	0.0170	0.0497	0.2168	-0.2191	-0.0022	0.0644
3	Iwate	46482	0.0179	0.0504	0.2280	-0.2304	-0.0023	0.0659
4	Miyagi	84776	0.0226	0.0505	0.1993	-0.2013	-0.0020	0.0710
5	Akita	35280	0.0156	0.0501	0.2606	-0.2633	-0.0027	0.0631
6	Yamagata	39433	0.0162	0.0478	0.2369	-0.2394	-0.0025	0.0616
7	Fukushima	80572	0.0179	0.0476	0.2039	-0.2060	-0.0021	0.0634
8	Ibaraki	119807	0.0159	0.0420	0.1567	-0.1583	-0.0016	0.0563
9	Tochigi	81531	0.0151	0.0395	0.1497	-0.1513	-0.0016	0.0530
10	Gunma	74860	0.0187	0.0468	0.1884	-0.1904	-0.0020	0.0634
11	Saitama	203713	0.0195	0.0461	0.1660	-0.1678	-0.0017	0.0638
12	Chiba	195319	0.0201	0.0458	0.1701	-0.1718	-0.0018	0.0641
13	Tokyo	778489	0.0265	0.0492	0.1960	-0.1980	-0.0020	0.0737
14	Kanagawa	309801	0.0235	0.0479	0.1759	-0.1777	-0.0018	0.0697
15	Niigata	92849	0.0183	0.0510	0.2308	-0.2333	-0.0025	0.0667
16	Toyama	48318	0.0149	0.0415	0.1904	-0.1924	-0.0020	0.0543
17	Ishikawa	44808	0.0206	0.0483	0.1853	-0.1871	-0.0019	0.0671
18	Fukui	33516	0.0169	0.0461	0.2036	-0.2057	-0.0022	0.0608
19	Yamanashi	33517	0.0155	0.0383	0.1629	-0.1646	-0.0017	0.0520
20	Nagano	87329	0.0185	0.0449	0.2124	-0.2146	-0.0022	0.0613
21	Gifu	74017	0.0161	0.0428	0.1837	-0.1856	-0.0019	0.0569
22	Shizuoka	160258	0.0182	0.0447	0.1849	-0.1868	-0.0019	0.0609
23	Aichi	361629	0.0188	0.0401	0.1462	-0.1477	-0.0016	0.0574
24	Mie	78616	0.0174	0.0430	0.1863	-0.1882	-0.0019	0.0585
25	Shiga	60338	0.0181	0.0419	0.1629	-0.1646	-0.0017	0.0583
26	Kyoto	93248	0.0228	0.0502	0.2162	-0.2184	-0.0022	0.0708
27	Osaka	389299	0.0231	0.0504	0.2036	-0.2057	-0.0021	0.0714
28	Hyogo	185442	0.0210	0.0505	0.2035	-0.2057	-0.0021	0.0694
29	Nara	37342	0.0184	0.0506	0.2005	-0.2026	-0.0021	0.0670
30	Wakayama	35249	0.0175	0.0522	0.2514	-0.2540	-0.0026	0.0671
31	Tottori	20373	0.0213	0.0593	0.2571	-0.2599	-0.0028	0.0778
32	Shimane	25382	0.0166	0.0474	0.2440	-0.2465	-0.0025	0.0615
33	Okayama	78276	0.0203	0.0486	0.2181	-0.2203	-0.0023	0.0667
34	Hiroshima	122949	0.0210	0.0473	0.1996	-0.2017	-0.0021	0.0661
35	Yamaguchi	59920	0.0158	0.0420	0.2104	-0.2126	-0.0022	0.0555
36	Tokushima	28384	0.0187	0.0494	0.2242	-0.2265	-0.0023	0.0658
37	Kagawa	37149	0.0188	0.0481	0.2168	-0.2191	-0.0023	0.0647
38	Ehime	49885	0.0199	0.0513	0.2301	-0.2325	-0.0024	0.0688
39	Kochi	21939	0.0200	0.0544	0.2663	-0.2692	-0.0029	0.0716
40	Fukuoka	188141	0.0254	0.0555	0.2188	-0.2211	-0.0023	0.0786
41	Saga	27921	0.0184	0.0530	0.2342	-0.2367	-0.0025	0.0689
42	Nagasaki	42518	0.0195	0.0555	0.2559	-0.2586	-0.0027	0.0723
43	Kumamoto	56038	0.0205	0.0552	0.2532	-0.2559	-0.0027	0.0731
44	Oita	48151	0.0174	0.0440	0.1975	-0.1996	-0.0021	0.0593
45	Miyazaki	36291	0.0207	0.0525	0.2290	-0.2315	-0.0025	0.0708
46	Kagoshima	55418	0.0224	0.0570	0.2807	-0.2837	-0.0030	0.0763
47	Okinawa	32460	0.0294	0.0646	0.2098	-0.2122	-0.0024	0.0916
48	Total	5031582	0.0211	0.0480	0.1964	-0.1985	-0.0020	0.0671

Max/Min						
Max/Min	1.9726	1.6877	1.9206	1.9205	1.9103	1.7615

Note: The shaded values denote maximum or minimum in each household's classification.

The highest increase rate in the effect on young households is in Okinawa Pref. (0.0294%), followed in order by Tokyo (0.0265%), Fukuoka (0.0254%), Kanagawa (0.0235%), Hokkaido (0.0235%), Osaka (0.0231%), and Kyoto (0.0228%). Based on the results, in an urban area with many young households and a low ratio of elderly people, an increase in GRP by an increase in the benefit rate of long-term care insurance is brought about by the strong effect of an increase in young household consumption.

However, the highest decrease rates found for households that include both elderly care households and elderly care households is Kagoshima Pref. (0.0030%), followed in order by Kochi (0.0029%), Tottori (0.0028%), Nagasaki (0.0027%), Akita (0.0027%), Kumamoto (0.0027%), and Wakayama (0.0026%). Based on the results, in rural areas where the elderly person ratio is high, an increase in GRP is brought about by the strong effect of an increase in elderly household consumption.

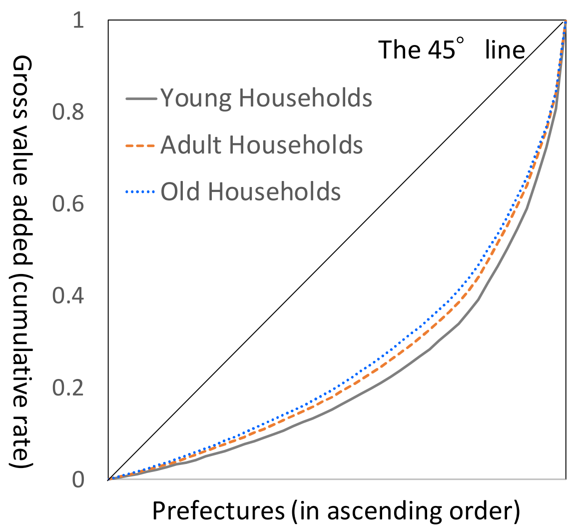

Figure 2 Lorenz curve of induced added value brought about by each household within prefectures.

Table 8 Gini coefficient of induced gross added value and GRP brought about by each household

GRP	Total Households	Young Households	Adult Households	Old Households		
				Elderly Care Households	No Elderly Care Households	Total
0.49454	0.50922	0.54547	0.49148	0.46590	0.46587	0.46388

We examine the induced gross added value of each prefecture with a Lorenz curve and the Gini coefficient. Figure 2 shows the Lorenz curve within prefectures. In calculating the Lorenz curve, we divide the induced gross added value based on production into households of three types. The horizontal line scale shows prefectures arranged in ascending order. The vertical line shows the cumulative ratio of the induced value of each prefecture. The rising right line in the figure represents the 45 degree line. The difference of induced value within a prefecture is small if the Lorenz curve is close to the 45 degree line. Otherwise, the difference is large.

Table 8 shows the Gini coefficient derived by the same calculation for induced gross added value and GRP brought about by the consumption of every household, in addition to the Gini coefficient that is derived by the Lorenz curve in Figure 2. The Gini coefficient is between 0 and 1. The large Gini coefficient underscores the inequality within regions. As shown by Table 8, the Gini coefficient of GRP is 0.495. However, the Gini coefficient of total households is 0.509. This result demonstrates that an increase in the benefit rate of long-term care insurance raises the GRP in the respective prefectures. However, an increase in GRP differs within prefectures. The inequality of consumption of total households is greater than the inequality of GRP within prefectures.

Moreover, review of the Gini coefficients of each type of household reveals that young households have a coefficient of 0.545: the largest. Older households have a coefficient of 0.464: the smallest. This result indicates that the effect of a young household, that is, an increased effect on GRP, is biased to a great degree at the specific area, compared with the present inequality within prefectures. However, the decrease effect on GRP brought about by the consumption of older households is equally distributed within prefectures. Based on the results presented in Table 7, we can expect that the former effect is concentrated to specific urban areas in which many young households exist. However, the latter effect is equally distributed to rural areas in which the ratio of elderly residents is high.

V Concluding Remarks

This study examines how a subsidy for long-term care affects a regional economy theoretically and empirically. For theoretical analysis, we develop a three-period overlapping-generations model to examine how a subsidy for long-term care affects the consumption and saving of households. We derive results using numerical examples. Precautionary saving reduces the aggregate consumption, which consequently reduces GDP. A decrease in self-care costs achieved through long-term care insurance reduces precautionary saving. Therefore, aggregate consumption increases. Subsequently, GDP is raised.

We note the following results obtained from these analyses. First, a decrease in self-care costs in long term care insurance raises the premium of long-term care insurance. An increase in the premium can reduce consumption because of a decrease in disposable household income. However, because of a decrease in precautionary saving, consumption by young and adult generations is raised. Consumption by elderly people can be reduced by an increase in the long-term care insurance premium even if the benefit of long-term care increases. This increase can raise consumption: some difference arises in terms of the effect on consumption among generations.

It is especially noteworthy that a decrease in self-care cost of long-term care raises GDP and GRP. Even if the GRP can be raised in every prefecture, the degree of increase in GRP differs among prefectures. For that reason, interregional inequality of GRP is magnified. Our paper presents derivation of the tradeoff between an increase in GDP as a total economic activity and the equality of GRP as an index of equality of interregional economic activity.

Moreover, we can consider another aspect of long-term care insurance. A decrease in the self-care cost of long-term care insurance can raise demand for long-term care services provided by the market. Then, the informal elderly care provided by the family can decrease, as reported by Yasuoka (2018). This result brings about an increase in labor population. However, these analyses do not consider this aspect. That task is left for examination in future research.

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[1] People using elderly care in Japan reached approximately 6.44 million in 2018, increasing from 2.18 million people in 2000 (Data: Ministry of Health, Labour and Welfare, Japan).

[2] Among the research efforts exploring saving behavior under uncertainty, Leland (1968), Caballero (1991), Liljas (1998), Picone et al. (1998), and Hemmi et al. (2007) theoretically explain the existence of precautionary saving.

[3] Ito and Takahashi (2000) examine the effects of long-term care insurance using regional input–output analysis. Hamamoto and Nakatani (2007) examine the effects of aging population on household consumption and government expenditure using input–output analysis.

[4] Based on explanations by Hamamoto and Nakatani (2007), we set re-allocation of the consumption expenditure in *Kakei Chousa Nenpou* (Statistics Japan, 2006a) as the consumption expenditure of each age level and each industrial sector.

[5] See Statistics Japan (2006a, 2006b, 2010).

[6] This study does not consider the firm optimization problem. The interest rate and wage rate are given exogenously. This assumption is not unusual. Generally, this assumption reflects a small open economy.

[7] By Japan’s long-term care insurance, people aged 40–64 years can obtain benefits of long-term care insurance if they have a specific medical condition. This study does not consider this benefit because the proportion of people receiving such care is very small.

[8] The input–output table is set at 2005. Therefore, we can set the parameter for theoretical analysis as 2005. However, we derive the result as recently as possible and use 2015 data to set the parameters.