

A Service of

ZBW

Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics

Fujii, Yoichiro; Inakura, Noriko

Article

Do individuals have consistent risk preferences across domains? Evidence from the Japanese insurance market

Journal of Applied Economics

Provided in Cooperation with: University of CEMA, Buenos Aires

Suggested Citation: Fujii, Yoichiro; Inakura, Noriko (2022) : Do individuals have consistent risk preferences across domains? Evidence from the Japanese insurance market, Journal of Applied Economics, ISSN 1667-6726, Taylor & Francis, Abingdon, Vol. 25, Iss. 1, pp. 604-620, https://doi.org/10.1080/15140326.2022.2045468

This Version is available at: https://hdl.handle.net/10419/314177

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.



https://creativecommons.org/licenses/by/4.0/

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



WWW.ECONSTOR.EU





Journal of Applied Economics

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/recs20

Do individuals have consistent risk preferences across domains?: evidence from the Japanese insurance market

Yoichiro Fujii & Noriko Inakura

To cite this article: Yoichiro Fujii & Noriko Inakura (2022) Do individuals have consistent risk preferences across domains?: evidence from the Japanese insurance market, Journal of Applied Economics, 25:1, 605-621, DOI: <u>10.1080/15140326.2022.2045468</u>

To link to this article: https://doi.org/10.1080/15140326.2022.2045468

© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



0

Published online: 03 Apr 2022.

ß

Submit your article to this journal \square

Article views: 954



View related articles 🖸

🕨 View Crossmark data 🗹



Citing articles: 1 View citing articles

DEVELOPMENT ECONOMICS

OPEN ACCESS OPEN ACCESS

Routledae

Taylor & Francis Group

Do individuals have consistent risk preferences across domains?: evidence from the Japanese insurance market

Yoichiro Fujii^a and Noriko Inakura^b

^aSchool of Commerce, Meiji University, Chiyoda, Japan; ^bFaculty of Management and Information Science, Shikoku University, Tokushima-shi, Japan

ABSTRACT

The risk attitude plays an important role in analyzing decision making under uncertainty. It is essential to confirm whether the risk aversion parameter in a certain situation, called "domain," can be applied to other situations. Using a dataset on hospitalization insurance policies in Japan, this study tests whether individuals' risk preferences remain consistent across domains. Based on the assumption of expected utility maximizer, we derive a plausible distribution of the degree of risk aversion. We find that degree of risk aversion is consistent between hospitalization benefits and additional insurance for specific diseases. Contrarily, the degree of risk aversion from hospitalization benefits has a negative relationship with that based on a survey question on the self-assessment of general preferences. This result indicates that the imputation of risk aversion from the literature would distort research results markedly if characteristics of the domains targeted by both previous research and this study differ.

ARTICLE HISTORY

Received 30 September 2020 Accepted 18 February 2022

KEYWORDS

Risk attitude; domain; internal validity and external validity; insurance choices

1. Introduction

The degree of risk aversion plays an important role when analyzing decision making under risk and uncertainty. It affects many decisions such as occupation, portfolio, insurance, and health behaviors. In principle, researchers treat risk preferences as context-invariant, which means that an individual has a specific utility function defined over final wealth. In other words, an individual's risk preference parameter should be stable, independent of any decision-making scenarios, namely the "domains" he/she faces.^{1,2} Specific examples of domains include insurance contracts, selection of financial assets, and general lotteries. If the estimated parameters meet the above principle, then those parameters have

CONTACT Yoichiro Fujii 🖾 fujii@meiji.ac.jp 🖃 School of Commerce, Meiji University, 1-1 Kanda-Surugadai, Chiyoda-ku Tokyo, Chiyoda, 101-8301 Japan

This article has been republished with minor changes. These changes do not impact the academic content of the article. ¹The data for this research were provided by (1) the Japan Institute of Life Insurance and (2) the Social Science Japan Data Archive, Center for Social Research and Data Archives, Institute of Social Science, The University of Tokyo. We are grateful to both organizations for providing the data. We also thank Yoshiro Tsutsui, Yoshihiko Suzawa, Shinji Takenaka, and the participants of the Asia-Pacific Risk and Insurance Annual Meeting 2017 held at Poznań University. This work was supported by JSPS Kakenhi Grant Number 17K03637(Fujii), 19K23223 (Inakura) and 21K01393 (Fujii).

²Domain in this paper does not refer to the mathematical term "domain."

© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/ by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

internal validity. Moreover, if the parameter estimated in a certain domain has predictive power for actual risky behaviors, then *external validity* is satisfied in this case.³

Contrarily, if the above principle is not fulfilled, then the following problem arises. For example, when performing calibration, researchers often use the estimated risk aversion obtained from previous research. If the internal and external validity is not satisfied, then using the degree of risk aversion obtained from previous studies targeting different domains could provide meaningless conclusions. Thus, the internal and external validity of the risk aversion determines the credibility of the research results.

In summary, there is insufficient consensus as to whether the internal and external validity of an individual's risk aversion is satisfied. The purpose of this study is to determine whether internal and external validity are satisfied by focusing on multiple domains with different characteristics based on the assumption that individuals act to maximize expected utility.

Hence, using micro-level data with rich information on hospitalization insurance policies in Japan, we estimate the degree of individual risk aversion based on information on hospitalization benefits. Next, we compare the estimated values with those based on two other domains; namely, (a) individuals' subscription to additional medical insurance policies and (b) answers to a question on the self-assessment of general preferences towards risk. We find a consistent relationship with the former domain but not with the latter. These results suggest that external validity exists among domains with high similarity in relation to medical insurance. However, internal validity among domains with less similarity does not exist. That is, this study strongly accentuates the importance of paying close attention to the similarity of domains when utilizing risk aversion estimates from previous studies.

The remainder of the paper is organized as follows. Section 2 reviews the relevant existing studies. Section 3 describes the model of individual choice for various hospitalization benefits as well as the calibration method used in this study. Section 4 outlines the data. Section 5 presents the estimated results. Finally, Section 6 concludes.

2. A brief summary of the related literature

Given that a growing body of literature aims to verify the internal and external validity of risk aversion estimates, we first review studies on internal validity and, then, review studies on external validity.

2.1. Internal validity

Many studies verify that in laboratory experiments such as lottery choices, differences in the design of the experiment, such as the setting of lotteries and the payoff amount, affect the estimation result of an individual's degree of risk aversion

³Schildberg-Hörisch (2018) surveys a wide range of studies and organizes the measurement and definition methods of preference stablity. Banks, Bassoli, and Mammi (2020); Görlitz and Tamm (2020); and Innocenti, Clark, McGill, and Cuñado (2019) indicate that various life events such as childbirth, illness, and vicarious experiences affect risk attitudes.

(Attanasi, Georgantzis, Rotondi and Vigani, 2018; Bauermeister, Hermann, and Musshoff. 2018; Binswanger, 1980; Csermely and Rabas, 2016; Eckel and Grossman, 2008; Ioannou and Sadeh, 2016; Reynaud and Counture 2012; Walelign, Nielsen, Jiao, and Jacobsen, 2019; Wik, Kebede, Bergland, and Holden, 2004). The results for validity are mixed. According to Anderson and Mellor (2009), who survey studies applying a within-subjects design, the degree of risk aversion of the same individual estimated for multiple domains can be inconsistent.⁴

Contrarily, Dohmen et al. (2011), who compare a subject's risk preference derived from lottery choice in a laboratory with that derived from questions on self-reported willingness to accept risk, find that willingness to accept risk is a significant predictor of risk-taking behavior in the laboratory. Moreover, Tausch and Zumbuehl (2018) investigate the relationship between self-stated willingness to take risk and exogenous economic information. They find that people have inconsistent risk aversion when exposed to various economic news.

Furthermore, some studies verify internal validity using field data. Barseghyan, Prince, and Teitelbaum (2011) reject the hypothesis that households have stable risk preferences when choosing automobile and home insurance policies. Einav, Finkelstein, Pascu, and Cullen (2012) show that only 30% of individuals behave consistently regarding risk aversion when presented with five domains for employer-provided insurance and 401(k) portfolio choices. Gürdal Kuzubaş and Saltoğlu (2017) find a positive correlation between measurement methods of risk attitude using a large non-student sample.

2.2. External validity

Another stream of literature aims to verify external validity. Wolf and Pohlman (1983), using hypothetical and actual bid data, find that Treasury Bill dealers are more risk averse in the actual investment context than in a hypothetical context. Fellner and Maciejovsky (2007) show that the coefficients of risk aversion from lottery choices are systematically correlated with market behaviors. Menapace, Colson, and Raffaelli (2016) focus on farmers' attitudes toward risk and show that self-assessment questions cannot significantly explain actual behavior when purchasing crop insurance. However, they also report that large stakes gambling tasks with a specific framing can statistically and significantly explain farmers' actual behavior in this setting. This result suggests that some hypothetical questions are consistent with actual behavior, whereas others are not.

Additionally, Fujii and Inakura (2019) examine the gap in risk aversion between hypothetical and actual choices in medical insurance, and report that the gap varies depending on respondents' anxiety about future medical expenses, their level of financial literacy, and other personal attributes such as age and occupation. Sharma and Schoengold (2016) compare the risk preferences of crop producers derived from actual on-farm production with choices from a simple lottery and find that revealed risk preferences derived from actual production decisions correlate with stated risk preferences derived from lottery selection.

⁴A within-subjects design is an approach to elicit risk preferences for the same subject by using more than one method.

Leon and Pfeifer (2017) analyze the relationship between individual religion and risk aversion, finding that the higher the willingness to take risks in financial matters, the higher the probability of holding stocks, fixed interest securities, and life insurance. In other words, the result imply that there is not necessarily a linear relationship between an individual's degree of risk aversion and the degree of volatility of the assets held.

3. Model and calibration method

Following Einav et al. (2012), we analyze the behavior of individual i(i = 1, ..., N) with respect to choosing hospitalization insurance coverage j(j = 0, ..., M) under relative risk aversion γ_i . This model assumes that all individuals are utility maximizers who have a single concave utility function over wealth. In this model, individuals pay insurance premium p_j for option j. Option 0 means no insurance premium is paid; instead, high medical expenses are incurred.

Thus, individual *i* evaluates expected utility v_{ij} as

$$v_{ij} = E_{\tilde{c}} \left[u_i \left(w_i - oop_j(\tilde{c}) - p_j \right) \right]$$
(1)

where $E_{\tilde{c}}$ is the expectation of random treatment cost \tilde{c} , u_i indicates individual *i*'s invariant vNM utility function, w_i signifies individual *i*'s income, $oop_j(\tilde{c})$ denotes the outof-pocket expenditure associated with cost realization \tilde{c} under coverage *j*, and p_j represents the premium associated with coverage *j*. Consistent with many previous studies (Mehra and Prescott (1986) and Geweke (2001)), we employ the CRRA utility function defined by

$$u_{i} = \begin{cases} \frac{z^{1-\gamma_{i}}}{1-\gamma_{i}} \text{if } \gamma_{i} \neq 1\\ \ln(z) \text{if } \gamma_{i} = 1 \end{cases}$$

$$\tag{2}$$

Here, y_i is the coefficient associated with individual *i*'s level of risk aversion.

We assume that individual *i* faces loss c_a with probability q_a and no loss with probability $(1 - q_a)$. The subscript *a* represents age, indicating that individuals' probability of being hospitalized (and incurring the respective hospitalization costs) depends on their age. Therefore, individual *i*'s expectations can be represented as

$$E_{\tilde{c}}\left[u_i\left(w_i - oop_j(\tilde{c}) - p_j\right)\right] = q_a u_i\left(w_i - oop_j(c_a) - p_j\right) + (1 - q_a)u_i\left(w_i - p_j\right).$$
(3)

We also calibrate the estimates of relative risk aversion parameter γ_i . First, Equation (3) is estimated for individual *i* for all options from 0 to *M* at γ_i . Since γ_i can take any value between $-\infty$ and $+\infty$, Equation (3) is calculated for each option while gradually shifting the value of γ_i . Moreover, since individuals are assumed to maximize their expected utility, if individual *i* chooses option *j*, it means that Equation (3) under *j* is the maximum value relative to those calculated from the other options. That is, there exists a γ_i that maximizes Equation (3) under *j* for individual *i*; here, γ_i represents the value of risk aversion for individual *i*. Hence, when individuals with the same attributes choose different insurance options, this is reflected by a difference in γ_i .

4. Data

4.1. Overview

This study uses the Survey on Life Protection in 2016 (hereafter, SLP), compiled by the Japan Institute of Life Insurance to measure individuals' risk aversion.

The survey outline is as follows. First, the content of the question relates to individuals' lifestyles (such as level of savings and private insurance policies held against various future risks).⁵ Since this survey is not a household survey but rather an individual one, the information on income and private insurance policies is ideal for application on an individual basis. Moreover, the content of the survey is diverse and includes questions on hospitalization experience, hospitalization expenses, confidence in the public social security system, and preferences for risk or return trade-offs. Second, subjects are men and women aged 18–69 years old across Japan selected by using the stratified two-stage random sampling method. The number of respondents is 4,056. However, respondents with a positive labor income are targeted because our decision model presumes that they choose coverage options by themselves.

Table 1 presents the summary statistics of the subjects analyzed. Both men and women have an average age of 46, and approximately 80% hold private insurance. Educational background, employment type, and personal income differ by sex as follows. The proportion of male university graduates is about 20 percentage points higher than that of women. About half of the female respondents work in irregular employment as compared to less than 10% for men. Personal annual income is 4.8 million Japanese yen (JPY) for men and JPY 2.1 million for women on average.⁶

4.2. Insurance premium for hospitalization benefits

Insurance products are typically sold as packages; individual insurance policies provide protection against various risks, including death, specific illnesses, hospitalization, nursing care, and other negative outcomes.⁷ For example, it is possible to add medical insurance to an insurance policy that covers the insured individual's death. Conversely, it is possible to add death insurance to a medical insurance policy. Hence, to determine the amount that individuals are willing to pay for insurance against hospitalization, it is necessary to specify the proportion of the premium allocated to death benefits, hospitalization benefits, and other riders.

In the SLP, rich information on individuals' insurance policies is available (total amount of annual insurance premiums, risks covered, and benefit amounts). Table 2 shows the summary statistics for this information for respondents with positive insurance premiums (excluding respondents that pay their insurance premiums in a lump sum). The average annual premium is JPY 174,390. For daily hospitalization benefits, we established three

⁵Although all residents in Japan are obliged to join both a public medical insurance and a public pension plan under the universal coverage system, a large percentage of the people have contracts with private life insurance companies for medical insurance and personal pensions. According to Swiss Re (2018), Japan's life premium volume in 2017 is the world's third largest after the United States and China.

⁶If converted at the most recent rate of JPY 110 to US\$ 1, then JPY 4.8 million would correspond to about US\$ 44,000.
⁷Some of these specific illnesses include cancer, acute myocardial infarction, and stroke. If insured individuals become ill from these diseases, they can receive sums of money equivalent to the amount distributed in the event of the insured individual's death.

Table 1. Descriptive statistics.

	Men(N	N = 924)	Womer	(N = 984)
	Mean	Std. Dev.	Mean	Std. Dev.
Hold a life insurance policy (Yes = 1, $No = 0$)	0.768	0.422	0.786	0.411
Age	46.214	12.865	46.188	12.087
Marital status (Married = 1, Unmarried = 0)	0.712	0.453	0.690	0.463
Final education				
Under high school degree	0.445	0.497	0.451	0.498
College graduate	0.159	0.366	0.356	0.479
Bachelor's degree or above	0.396	0.489	0.193	0.395
Employment status				
Working for a private company or public office	0.764	0.425	0.426	0.495
Self-employed or family worker, or freelance	0.148	0.356	0.106	0.308
Temporary employee or part-time worker	0.088	0.283	0.468	0.499
Personal income (unit: JPY)				
I less than 1 million	0.024	0.153	0.313	0.464
II 1 million ~ less than 2 million	0.088	0.283	0.276	0.447
III 2 million ~ less than 3 million	0.160	0.367	0.172	0.377
IV 3 million ~ less than 5 million	0.305	0.461	0.169	0.375
V 5 million ~ less than 7 million	0.239	0.427	0.054	0.226
VI 7 million ~ less than 10 million	0.121	0.327	0.012	0.110
VII over 10 million	0.063	0.243	0.004	0.064
Personal income (unit: JPY 10,000)	489.287	278.333	211.743	175.310

Note) To estimate the mean and standard deviation of personal income with binned data, we used the multimodel generalized beta estimator developed by von Hippel, Scarpino, and Holas (2016). They also made the method available as mgbe commands for Stata.

Table 2.	Summary	statistics	of insurance	policies.
----------	---------	------------	--------------	-----------

Insurance premium and ammount (Unit: JPY 10,000)	Mean	Std. Dev.	Min	Max
Total insurance premium per year	17.439	13.863	1	84
Ammount of hospitalization benefit per day				
Option 1 (less than JPY 10,000 per day)	0.526	0.148	0.1	0.950
Option 2 (over JPY 10,000)	1.326	0.466	1	3.000
Amount of annuity per year	9.888	25.342	0	150
Amount of death benefits	1048.095	1110.201	0	6000
Percentage of contractors	(%)			
Hospitalization benefits				
Option 0 (uninsured)	5.4			
Option 1 (less than JPY 10,000 per day)	46.1			
Option 2 (over JPY 10,000)	48.5			
Annuity insurance	26.1			
Riders for:				
Cancer	47.5			
Special diseases	43.1			
Nursing care status	9.9			

Note) Number of observations = 1370.

Limited to respondents who hold life insurance policies and pay positive insurance premiums.

categories: Option 0 (uninsured), Option 1 (less than JPY 10,000), and Option 2 (over JPY 10,000). Altogether, 46.1% of respondents are categorized as Option 1 (average benefit = JPY 5,260) and 48.5% as Option 2 (average benefit = JPY 13,260). The remainder (5.4%) are uninsured. The average death insurance payout is about JPY 9.8 million. Further, 26.1% hold annuity insurance, and more than 40% held policies that included riders for cancer and other diseases. In contrast to these relatively high percentages, only 9.9% of respondents held special policies that give them nursing care insurance.⁸

⁸If the insured becomes bedridden to the point of requiring care, the insurance may pay out a lump sum or an annuity.

We next estimate the insurance premiums paid to hold Options 1 and 2.⁹ First, we perform an ordinary least squares regression, using the annual insurance premium as the dependent variable. The independent variables are the policy statuses for the different types of insurance. This regression equation is modeled as follows.

Total premium_i = $\alpha_1 \times (Dummy Variable for Holding Option1)_i$ + $\alpha_2 \times (Dummy Variable for Holding Option2)_i$ + $\alpha_3 \times (Amount of Death Benefit)_i$ + $\alpha_4 \times (Annual amount of individual annunity insurance)_i$ + $\alpha_5 \times (Dummy Variable for Holding Cancer Insurance)_i$ + $\alpha_6 \times (Dummy Variable for Holding Specific Disease Insurance)_i$ + $\alpha_7 \times (Dummy Variable for Long - term Care Insurance)_i$.

Given the above, $\hat{\alpha}_1$ and $\hat{\alpha}_2$ represent the annual insurance premiums for Options 1 and 2, respectively. Column (1) in Table 3 shows the estimation results. Since insurance premiums are partially determined by age and sex, we add age and sex as predictors in column (2). The estimated coefficient of Option 1 in column (2) is 2.876, and that of Option 2 is 8.201, which means that a respondent who holds Option 1 pays JPY 28,760 - per year for hospitalization benefits as compared to JPY 82,010 per year for Option 2. We use the estimated premiums shown in column (2) as p_j in equations (1) and (3).

	(1)	(2)
Hospitalization benefits		
Dummy variable of		
Option 1	7.017***	2.876**
	(0.514)	(1.221)
Option 2	12.256***	8.201***
	(0.687)	(1.318)
Amount of death benefits	0.004***	0.004***
	(0.000)	(0.000)
Amount of annuity insurance	0.181***	0.172***
	(0.016)	(0.016)
Contracting riders for:		
Cancer	1.220*	1.049
	(0.657)	(0.661)
Special diseases	2.700***	2.706***
	(0.695)	(0.699)
Nursing care	1.356	1.418
	(1.127)	(1.116)
Age		0.096***
		(0.023)
Sex		-0.276
		(0.625)
Observations	1,370	1,370
Adjusted R-squared	0.724	0.728

Table 3. Determinants of total premiums.

Note) Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

⁹Premium information for options 1 and 2 is not available, so it is necessary to estimate these premiums from the total annual premium and the insurance coverage.

4.3. Probability of hospitalization and out-of-pocket costs due to hospitalization

Regarding the hospitalization probability, q_a , and out-of-pocket costs, $oop_j(c_a)$, in equation (3), we use the information on hospitalization experience within the past five years taken from the SLP. For hospitalization probability, two calculation methods are adopted (Figure 1): (i) the probability of hospitalization is assumed to be constant across ages (14.9%), and (ii) the probability of hospitalization is assumed to vary by age.

Next, out-of-pocket costs $oop_j(c_a)$ are derived as follows. The SLP asks questions about latest hospitalization experience within the past five years with respect to (i) the direct expenses paid to hospitals and indirect expenses (meals, daily necessities, transportation) and (ii) hospitalization days. Direct expenses here are calculated as total costs minus the hospitalization benefits paid from the public health insurance system, including the high-cost medical expense benefit. As shown in Table 4, the average values of (i) and (ii) are JPY 219,000 (approximately USD 2,000) and 17.8 days, respectively. Then, the average of (i)/(ii) is JPY 19,800 (approximately USD 180). That is, daily hospitalization costs are JPY 19,800 plus the lost income per day calculated from the individual's personal annual income.



Figure 1. Percentage of respondents who have experience of hospitalization within the past five years Source) Calculated from the SLP.

Table 4	I. Hospitalization	expenses and	l number	of hospital	days.
---------	--------------------	--------------	----------	-------------	-------

	Mean	Std. Dev.	Min	Max
(a) Total value of direct and indirect costs (unit: JPY 10,000)	21.960	27.990	0.4	200
(b) Number of hospital days	17.875	21.904	1	150
(a) / (b) = Self-paid hospitalization expenses per day	1.984	2.263	0.056	20.000

Source) Calculated from the SLP.

Note) N = 432.

Finally, we use the average number of hospital days for respondents aged 20– 69 years old (20.4 days), calculated from the Patient Survey (2014) of the Ministry of Health, Labour and Welfare in Japan. Therefore, out-of-pocket costs for individual *i* under Option *j* (*j* = 0, 1, 2) are calculated as ((19.8 + Lost income per day_i – benefit *j*) × 20.4). That is, the difference between individuals' out-of-pocket hospitalization costs arises from the difference between their income and the benefits from their insurance policy. In the next section, this study estimates individuals' relative risk aversion rate by assuming that they aim to maximize expected utility.

5. Empirical results

5.1. Estimating γ_i for hospitalization risk

Based on the calibration method described in Section 3, we estimate respondents' relative risk aversion γ_i . Tables 5 (a) and (b) present the estimated results for the cases where the hospitalization probability is fixed and vary across ages, respectively. Table 5 (a) indicates that the higher annual income, the higher is the estimated value of γ_i . For example, if individuals' income is below JPY one million (represented as "I" in the table) and they hold Option 1, and their γ_i is estimated to be 0.9. Contrarily, individuals whose income exceeds JPY 10 million ("VII" in the table) and who hold Option 1 have a γ_i value of 10.7. Moreover, if the income level is the same, the higher the option chosen, the higher the estimated value of γ_i . Figure 1 shows that the rate of hospitalization increases as age rises. Therefore, even with the same income and insurance coverage, the lower the respondent's age, the higher the estimated value of γ_i in Figure 2. For example, when holding Option 2 with an annual income of 4.8 million, which is the average value for men mentioned in the Data section ("IV" in the table), respondents' γ_i in their 20s is estimated to be 14.9 as compared to 4.5 in their 60s.

We next merge the estimated γ_i for selected respondents (workers from 20–69 years old; see Table 1). The differences in income, insurance policy, and age that cause different hospitalization probabilities bring about a variation in γ_i . Column (a) and (b) of Table 6 shows the summary statistics for the case where the probability of hospitalization is fixed (variable) across age groups. Figure 3 also shows the kernel density for γ_i . The average values are 5.29 in column (a) and 6.22 in column (b), with medians of 4.80 and 5.75, respectively. These values are largely consistent with previous studies of risk aversion in Japan. For example, Yoshikawa (2003), using time series data on a household's risky asset holding rate, finds that the estimated value in 2003 is between 1.96 and 3.07. Kamiya and Moridaira (2007), focusing on death insurance in Japan, estimate participants' level of risk aversion to be between 0.3 and 2.3.

5.2. Comparing risk aversion across domains

This study compares the estimated γ_i with those derived from the other two domains. First, Domain (a) is based on individuals' membership of additional medical insurance policies (known as riders). Therefore, this comparison verifies whether the estimated degree of risk aversion, γ_i , has external validity or not. As shown in Table 2, the proportions of the sample subscribing to cancer insurance, other disease-specific insurance, and nursing care

Income	Option 0	Option 1	Option 2	Age	Income	Option 0	Option 1	Option 2
1	0.5	0.9	1.4	20	1	1.1	1.8	2.4
II	2.0	3.2	4.3		П	4.3	6.0	7.7
III	3.2	4.8	6.4		III	6.8	9.1	11.3
IV	4.5	6.5	8.4		IV	9.5	12.2	14.9
V	5.9	8.1	10.3		V	12.3	15.4	18.4
VI	7.0	9.4	11.8		VI	14.7	17.9	21.0
VII	8.2	10.7	13.2		VII	17.1	20.3	23.5
				30	I	0.8	1.4	2.0
					II	3.3	4.8	6.2
					III	5.2	7.2	9.2
					IV	7.3	9.7	12.1
					V	9.5	12.2	14.9
					VI	11.4	14.2	17.0
					VII	13.3	16.2	19.0
				40	I	0.7	1.2	1.7
					II	2.8	4.2	5.5
					III	4.4	6.2	8.0
					IV	6.2	8.4	10.6
					V	8.0	10.5	13.0
					VI	9.6	12.3	14.9
					VII	11.2	13.9	16.6
				50	I	0.4	0.8	1.3
					II	1.7	2.8	3.9
					III	2.8	4.3	5.7
					IV	3.9	5.8	7.6
					V	5.1	7.2	9.3
					VI	6.0	8.3	10.6
					VII	7.0	9.4	11.8
				60	I	0.1	0.5	0.8
					II	0.7	1.6	2.4
					III	1.1	2.3	3.4
					IV	1.6	3.1	4.5
					V	2.1	3.9	5.6
					VI	2.5	4.4	6.3
					VII	2.9	5.0	7.1

Table 5. Estimated re	elative risk avers	sion coefficients	by income a	nd insurance options
(a) Fixed hospitalizati	on probability ((b) Variable hos	oitalization pr	obability.

Note) The calibration is executed in increments of 0.1.

The income classes corresponding to the Arabic numerals of I to VII are as follows: I: less than JPY 1 million, II: 1 million ~ less than 2 million, III: 2 million ~ less than 3 million, IV: 3 million ~ less than 5 million, V: 5 million ~ less than 7 million, VI: 7 million ~ less than 10 million, VII: over 10 million.

insurance are 47.5%, 43.1%, and 9.9%, respectively. As individuals holding these riders pay additional premiums, their degree of risk aversion is expected to be higher. Moreover, the benefits paid from a rider are not included in the hospitalization benefit amount used to estimate γ_i . That is, hospitalization benefits and rider benefits are exclusive.

Table 7 shows the consistency between γ_i and the degree of risk aversion inferred from Domain (a). The dependent variable is γ_i obtained in Section 5.1. Columns (1) and (3) represent those cases where the probability of hospitalization is fixed and variable, respectively. The coefficient estimates of the dummy variables for holding cancer insurance and disease-specific insurance are positive and statistically significant in all cases (see columns (1) to (4)). For example, the coefficient of holding cancer insurance in column (1) is estimated to be 0.851. This result means that relative risk aversion is 0.851 higher for those who hold cancer insurance than for those who do not if other conditions are fixed. Therefore, the γ_i estimated from the hospitalization insurance benefit and the degree of risk aversion for Domain (a) is consistent, and this result can mean that γ_i has external validity.



— Option 0 (Age = 20) — Option 1 (Age = 20) — Option 2 (Age = 20)
--■-- Option 0 (Age = 60) --○-- Option 1 (Age = 60) --■-- Option 2 (Age = 60)

Figure 2. γ_i for each insurance option by age.

Table 6. Basic	statistics for y	/ _i .
	(a)	(b)
Mean	5.29	6.22
Std. Dev.	3.09	4.21
Min	0.50	0.10
Median	4.80	5.75
Max	13.20	19.00

Note) N = 1908. Limited to respondents who work with a positive income

Probability of hospitalization is fixed across age groups and variables for (a) and (b), respectively.

Domain (b) relates to general risk aversion. More specifically, participants were asked to respond to the following question: "Do you prefer Option A or Option B? A: High profits with a possibility of loss. B: Low profits without a possibility of loss." Participants were asked to select Option A, Option B, "near" Option A, "near" Option B, or "I do not know." Figure 4 shows that participants largely gravitated toward the option that can be interpreted as the most risk averse (i.e., Option B). Moreover, there is no difference in the distribution of responses between the case that is limited to employees and the case of all samples of the SLP.

Again, each individual's γ_i obtained in Section 5.1 is taken as the dependent variable, and the answer to the question of general risk aversion is added as an independent variable. This formulation examines the internal validity as to whether the difference in the method of measuring the degree of risk aversion leads to inconsistency. We treated Options "A" and "near A" as the base case;



Figure 3. Kernel density plot of γ_i .

Note: Probability of hospitalization is fixed across age groups for (a) and variable for (b).

	(1)	(2)	(3)	(4)
	Fixed hosp proba	oitalization ability	Vari hospita proba	able lization ability
Age	-0.013***	-0.005*	-0 174***	-0.163***
	(0.003)	(0.003)	(0.004)	(0.004)
Income	0.010***	0.008***	0.011***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)
Holding additional schemes for	(,	(,	((
Cancer insurance rider (Yes = 1, No Contract = 0)	0.851***	0.796***	1.059***	0.990***
	(0.084)	(0.078)	(0.116)	(0.109)
Disease-specific rider (Yes $=$ 1, No Contract $=$ 0)	0.774***	0.787***	0.771***	0.789***
	(0.088)	(0.082)	(0.121)	(0.113)
Nursing care (Yes = 1, No Contract = 0)	0.052	0.089	0.134	0.189
	(0.143)	(0.132)	(0.196)	(0.184)
Marital status (Married = 1, Unmarried = 0)		-0.056		0.071
		(0.077)		(0.106)
Self-employed or family worker, or freelance		-0.577***		-0.961***
		(0.107)		(0.148)
l'emporary employee or part-time worker		-1.316***		-1./54***
First - desertion (Deserves - Under bight school de mars)		(0.093)		(0.128)
Final education (Base case = Under high school degree)		0 177**		0 222*
College graduate		-0.177***		-0.222"
Pachalar's degree or above		(0.064)		(0.110)
bacileion's degree of above		-0.318		-0.420
Sex (Male -1 Female -0)		0.501***		0.577***
Sex (Male = 1, Temale = 0)		(0.080)		(0 111)
Constant	2 004***	2 517***	9 889***	10 548***
Constant	(0.144)	(0.150)	(0.199)	(0.208)
Observations	1,908	1,908	1,908	1,908
Adjusted R-squared	0.750	0.784	0.746	0.777

Table 7 Completely between y ₁ for mospitulization benefits and daaltonal mach	Table 7.	Consistency	between	v_i for	hospitalization	benefits	and	additional	rider
--------------------------------------------------------------------------------------------------	----------	-------------	---------	-----------	-----------------	----------	-----	------------	-------

Note) Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1



Figure 4. Response to the general question about risk aversion. Source) Japan Institute of Life Insurance (2016) Survey on Living Security.

hence, the coefficients associated with the three other options indicate a deviation from the base case. Therefore, if the coefficient of "Near B" or "B" is positive and significant, there is consistency between the degree of risk aversion inferred from the question on general risk aversion and those estimated in Section 5.1. However, the estimated result shows the opposite. In Table 8, the coefficients of "Near B" and "B" are estimated as negative in columns (1) and (3). This finding means that individuals who answer "B" tend to have a lower γ_i than those who select "A" or "near A." That is, respondents considered to be more risk averse from the general question on risk tend to have lower γ_i values. Therefore, internal validity is not satisfied.

6. Conclusion

We first discuss the value of γ_i obtained from calibration, and state the contribution of this study on the external and internal validity of the estimated risk aversion.

Based on the assumption that individuals act to maximize expected utility, we derive a plausible distribution of γ_i by calibration, whose median values is about 5. Moreover, focusing on the relationship between age and risk aversion, it was observed in this study that the value of risk aversion decreases as age increases, given other conditions as constant. This means that older people are more risk-loving than young people. It seems to be counter-intuitive, but the following interpretation is possible.¹⁰ First, the age dummy in this study should be interpreted as a cohort effect rather than an age effect. In Japan, there is a clear intergenerational gap in social security benefits, and it is possible that young people (that is, younger cohorts) might be making risk averse choices

¹⁰The study of Dohmen, Falk, Golsteyn, Huffman, and Sunde (2017) shows that the younger the age, the more risk averse.

618 🕒 Y. FUJII AND N. INAKURA

	(1)	(2)	(3)	(4)	
	Fixed hosp	italization	Variable ho	pitalization	
	proba	bility	probability		
Age	-0.010***	-0.003	-0.170***	-0.161***	
	(0.003)	(0.003)	(0.004)	(0.004)	
Income	0.010***	0.008***	0.011***	0.009***	
	(0.000)	(0.000)	(0.000)	(0.000)	
Response for general question regarding risk (Base					
case = "A" or "Near A")					
Near B	-0.198	-0.106	-0.352*	-0.259	
	(0.148)	(0.139)	(0.198)	(0.187)	
В	-0.231*	-0.127	-0.390**	-0.275	
	(0.134)	(0.126)	(0.179)	(0.169)	
l don't know	-0.303	-0.297	-0.358	-0.352	
	(0.237)	(0.222)	(0.317)	(0.299)	
Marital status (Married = 1, Unmarried = 0)		-0.023		0.115	
		(0.084)		(0.113)	
Self-employed or family worker, or freelance		-0.498***		-0.873***	
		(0.117)		(0.158)	
Temporary employee or part-time worker		-1.347***		-1.790***	
		(0.102)		(0.137)	
Final education (Base case = Under high school degree)					
College graduate		-0.218**		-0.269**	
		(0.092)		(0.124)	
Bachelor's degree or above		-0.380***		-0.492***	
		(0.091)		(0.123)	
Sex (Male = 1, Female = 0)		0.501***		0.573***	
• · · ·		(0.088)	10	(0.119)	
Constant	2.651***	3.125***	10./25***	11.345***	
	(0.190)	(0.193)	(0.254)	(0.260)	
Observations	1,908	1,908	1,908	1,908	
Adjusted R-squared	0.704	0.741	0.714	0.746	

Iddle 6. Consistency between v: for nospitalization benefits and deneral risk aver	Table 8.	 Consistency 	between v.	for	hospitalization	benefits	and	general	risk	aversi
------------------------------------------------------------------------------------	----------	---------------------------------	------------	-----	-----------------	----------	-----	---------	------	--------

Note) Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

regarding the health domain of hospitalized medical insurance. Since the data used in this study are cross-sectioned, age and cohort effects could not be identified. Verification using panel data or pseudo panel data can be investigated in future studies. Furthermore, an extension to multi-attribute utility functions (such as Crainich, Eeckhoudt, and Le Courtois (2017) and Attema, l'Haridon, and van de Kuilen (2019)) gives scope for further studies.

The contribution of this study is as follows. By using a dataset with rich information on hospitalization insurance policies in Japan, we test whether individuals' risk preferences satisfy internal and external validity. We find that individuals' degree of risk aversion is consistent between the domains of hospitalization benefits and additional insurance for specific diseases. This result indicates external validity exists among domains with similar properties. On the contrary, γ_i and the answer to the question of general risk aversion have a negative correlation. Therefore, internal validity is not observed between domains with different properties. That is, no internal validity was observed between the hypothetical question of the general attitude to risk and γ_i as calculated from the real world of life insurance choices.

In summary, the above two results for external and internal validity highlight the importance of domain similarity. Einav et al. (2012), using a large dataset containing information on employee's medical insurance policies and 401(k) choices, found that each employee's degree of risk aversion was consistent within multiple medical insurance policies but inconsistent between medical insurance policies and 401(k) choices. The results of Einav et al. (2012), as well as those presented herein, indicate that individuals' degree of risk aversion for multiple domains with similar properties can be substituted, whereas they cannot be substituted for domains with different properties. This point is important, especially, when calibrating the economic model with a risk aversion, including relative risk aversion obtained from previous research. If the characteristics of the domains targeted by this study and previous studies differ, the imputation of risk aversion obtained in previous studies would distort the results of the literature markedly.

Finally, we discuss some future research directions. Individuals' choices depend not only on decision-makers' risk preferences but also on their subjective expectations about various outcome probabilities. We assumed that subjective expectations, namely the probability of a disease requiring hospitalization in our study, were constant among respondents of the same age. This assumption gives scope for future research to verify the consistency of the risk preferences among domains by using a model that can treat the subjective probability of each outcome endogenously.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the JSPS KAKENHI Grant Number 17K03637, 19K23223, and 21K01393.

Notes on contributors

Yoichiro Fujii has been associate professor at Meiji University since 2019. He received Ph.D in Economics from University of Tsukuba in 2010. His research fields are decision analysis under uncertainty and insurance economics.

Noriko Inakura has been associate professor at Shikoku University since 2020. She received Ph.D in Economics from University of Tsukuba in 2009. Her research fields are consumption and health economics.

References

- Anderson, L. R., & Mellor, J. M. (2009). Are risk preferences stable?: Comparing an experimental measure with a validated survey-based measure. *Journal of Risk and Uncertainty*, 39(2), 137–160.
- Attanasi, G., Georgantzis, N., Rotondi, V., & Vigani, D. (2018). Lottery- and survey-based risk attitudes linked through a multichoice elicitation task. *Theory and Decision*, 84(3), 341–372.
- Attema, A. E., l'Haridon, O., & van de Kuilen, G. (2019). Measuring multivariate risk preferences in the health domain. *Journal of Health Economics*, 64, 15–24.

- Banks, J., Bassoli, E., & Mammi, I. (2020). Changing attitudes to risk at older ages: the role of health and other life events. *Journal of Economic Psychology*, 79, 102208.
- Barseghyan, L., Prince, J., & Teitelbaum, J. C. (2011). Are risk preferences stable across contexts? American Economic Review, 101(2), 591–631.
- Bauermeister, G. F., Hermann, D., & Musshoff, O. (2018). Consistency of determined risk attitudes and probability weightings across different elicitation methods. *Theory and Decision*, 84(4), 627–644.
- Binswanger, H. P. (1980). Attitudes toward risk: experimental measurement in Rural India. *American Journal of Agricultural Economics*, 62(3), 395–407.
- Crainich, D., Eeckhoudt, L., & Le Courtois, O. (2017). Health and portfolio choices: A diffidence approach. *European Journal of Operational Research*, 259(1), 273–279.
- Csermely, T., & Rabas, A. (2016). How to reveal people's preferences: Comparing time consistency and predictive power of multiple price list risk elicitation methods. *Journal of Risk and Uncertainty*, 53(2-3), 107–136.
- Dohmen, T., Falk, A., Golsteyn, B. H. H., Huffman, D., & Sunde, U. (2017). Risk attitudes across the life course. *Economic Journal*, *127*(605), 95–116.
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3), 522–550.
- Eckel, C. C., & Grossman, P. J. (2008). Forecasting risk attitudes: An experimental study using actual and forecast gamble choices. *Journal of Economic Behavior & Organization*, 68(1), 1–17.
- Einav, L., Finkelstein, A., Pascu, I., & Cullen, M. R. (2012). How general are risk preferences? Choices under uncertainty in different domains. *American Economic Review*, 102(6), 2606–2638.
- Fellner, G., & Maciejovsky, B. (2007). Risk attitude and market behavior: Evidence from experimental asset markets. *Journal of Economic Psychology*, 28(3), 338–350.
- Fujii, Y., & Inakura, N. (2019). Factors widening the gap between hypothetical and actual choices: empirical evidence from the japanese medical insurance market. *Forthcoming in Asia-Pacific Journal of Risk and Insurance*, 13(2), 20180026, e2153–3792.
- Geweke, J. (2001). A note on some limitations of CRRA utility. *Economics Letters*, 71(3), 341–345.
- Görlitz, K., & Tamm, M. (2020). Parenthood, risk attitudes and risky behavior. *Journal of Economic Psychology*, 79, 102189.
- Gürdal, M. Y., Kuzubaş, T. U., & Saltoğlu, B. (2017). Measures of individual risk attitudes and portfolio choice: Evidence from pension participants. *Journal of Economic Psychology*, 62, 186–203.
- Innocenti, S., Clark, G. L., McGill, S., & Cuñado, J. (2019). The Effect of Past Health Events on Intentions to Purchase Insurance: Evidence from 11 Countries. *Journal of Economic Psychology*, 74, 102204.
- Ioannou, C. A., & Sadeh, J. (2016). Time preferences and risk aversion: Tests on domain difference. *Journal of Risk and Uncertainty*, 53(1), 29–54.
- Japan Institute of Life Insurance. 2016. Survey on Life Protection.
- Kamiya, S., & Moridaira, S. (2007). Seimeihoken jyuyou kara mita kiken kaihido suitei (in Japanese) [estimation of risk aversion from Japanese Life Insurance Market]. In A. Kogure (Ed.), *Risuku no Kagaku Kinyuu to Hoken* (pp. 73–98). Tokyo: Asakura Shoten.
- León, A. K., & Pfeifer, C. (2017). Religious activity, risk-taking preferences and financial behaviour: Empirical evidence from German survey data. *Journal of Behavioral and Experimental Economics*, 69(C), 99–107.
- Mehra, P., & Prescott, E. C. (1986). The equity premium: A puzzle. *Journal of Monetary Economics*, *15*(2), 145–161.
- Menapace, L., Colson, G., & Raffaelli, R. (2016). A comparison of hypothetical risk attitude elicitation instruments for explaining farmer crop insurance purchases. *European Review of Agricultural Economics*, 43(1), 113–135.
- Ministry of Health, Labour and Welfare. 2014. Patient Survey.

- Reynaud, A., & Couture, S. (2012). Stability of risk preference measures: results from a feld experiment on French farmers. *Theory and Decision*, 73(2), 203–221.
- Schildberg-Hörisch, H. (2018). Are risk preferences stable? *Journal of Economic Perspectives*, 32(2), 135–154.
- Sharma, S., & Schoengold, K. (2016). Do hypothetical choices indicate true risk preferences?: A comparison of stated and revealed data on decisions over risky outcomes. *Cornhusker Economics*, 728.
- Swiss Re (2018) World insurance in 2017: Solid, but mature life markets weigh on growth. Retrieved 29 September 2020. https://www.swissre.com/institute/research/sigma-research /sigma-2018-03.html
- Tausch, F., & Zumbuehl, M. (2018). Stability of risk attitudes and media coverage of economic news. *Journal of Economic Behaviour and Organization*, 150, 295–310.
- von Hippel, P. T., Scarpino, S. V., & Holas, I. (2016). Robust estimation of inequality from binned incomes. *Sociological Methodology*, 46(1), 212–251.
- Walelign, S. Z., Nielsen, M. R., Jiao, X., & Jacobsen, J. B. (2019). Is households' risk attitude robust to different experimental payoffs? *Applied Economics Letters*, 26(8), 703-706.
- Wik, M., Kebede, T. A., Bergland, O., & Holden, S. T. (2004). On the measurement of risk aversion from experimental data. *Applied Economics*, *36*(21), 2443–2451.
- Wolf, C., & Pohlman, L. (1983). The recovery of risk preferences from actual choices. *Econometrica*, 51(3), 843-850.
- Yoshikawa, T. (2003). Nihon ni okeru kakei no soutaiteki kikenkaihido no suii: 1970-2002 (in Japanese) [estimation of relative risk aversion in Japan]. *Keizai Kenkyu, Seijo University, 163,* 73–87.