Tax Literacy and Personal Investments for Post-Retirement Years

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Abstract

Facing the decreasing benefit of the public pension system in an aging society, the Japanese government offers various tax advantages to encourage personal investments for one’s post-retirement years. To understand their benefits, however, people need to have tax literacy, which, unlike financial literacy, has rarely been studied in previous studies. Using our unique data, we measure tax literacy separately from financial literacy and investigate its role in various investment decisions by employing the two-stage least squares estimation and a web experiment. We find that tax literacy is the key in increasing the participation rate for personal pension investments with tax benefits.

Keywords: Asset location, Retirement savings, Tax literacy, Financial literacy

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I. Introduction

Global trends on self-directed retirement account growth have highlighted the “asset location” problem introduced by Shoven (1999). Individual investors have to consider both asset allocation (which asset to hold, such as stocks and bonds) and asset location (in which accounts to hold them) in tax deferred accounts and the usual saving and brokerage accounts. Japan has experienced rapid population aging and a declining birthrate, and this has caused the financial condition of the public pension to worsen, and the benefit level to decline (Okumura and Usui 2014; Kitao 2018), which requires individuals to take more responsibility for their own retirement plans. In order to accumulate a satisfactory level of financial assets, the Japanese government offers various tax-advantaged savings and investment accounts.

Previous studies found that asset location is an important factor in household retirement savings. Shoven (1999) outlined the structure of the asset location problem and found that tax minimization usually indicates that heavily taxed bonds should be held in tax-deferred accounts, while less heavily taxed equities should be held in taxable accounts. Shoven and Sialm (2004) showed that locating assets optimally can significantly improve the risk-adjusted performance of retirement savings.

There are many empirical studies to show that households’ asset location choices are rather tax efficient. However, there is still room for improvement. Using the Survey of Consumer Finances (SCFs), Poterba and Samwick (2002) examined the impact of taxation on household portfolio choice and found that households with higher marginal tax rates are more likely to own tax-advantaged assets such as publicly traded stock and tax-exempt bonds than that of households with lower marginal tax rates. Amromin (2002) examined household asset location and precautionary savings and found that the standard deviation of household labor income is related to asset location choices, in that households in less risky occupations choose more tax-efficient asset locations. Using U.S. brokerage accounts, Barber and Odean (2004) investigated whether individual investors consider taxes when making asset location decisions. They found that an individual investor’s asset location pattern is broadly consistent with tax-minimizing behavior. However, they also found that these tax considerations are imperfect and several “location puzzles” exist. For example, many investors hold a taxable bond in their taxable account. They conclude that either the existing models of optimal asset location are incomplete, or a substantial fraction of investors are misallocating their assets. Using the SCFs, Bergstresser and Poterba (2004) explored asset location patterns and the relation between these patterns and household characteristics such as marginal tax rates and found that overall household asset location with financial assets in both taxable and tax-deferred accounts hold portfolios that are tax efficient. However, they also found that households also have tax-inefficient portfolios which could be tax efficient by re-allocating a small amount of financial assets.

Previous studies have demonstrated the importance of asset location, however, the driving factors of optimal asset location need to be considered. In order to allocate financial assets optimally, individual investors should have basic knowledge about tax and its impact on investment results. We call this type of human capital accumulation as “tax literacy.” Previous studies also demonstrated that financial literacy plays an important role in increasing the probability of having retirement saving plans (Lusardi and Mitchell 2011; Sekita 2011).

We conduct an original web survey to investigate the role of tax literacy in addition to financial literacy on personal investments. Through the original web survey, we obtain information on individuals’ level of tax literacy separately from financial literacy as well as individuals’ possession of different types of investments for post-retirement years. Furthermore, our web survey includes an experiment where we show tax benefit information to half of the randomly chosen respondents (treatment group) and ask willingness to have different types of investments, irrespective of being in the treatment group or not, to check the impact of tax benefit information on individual attitude towards different types of investments. Furthermore, it is challenging to deal with reverse causality to investigate the impact of financial literacy on individual decisions regarding the different types of investments.

The contribution of this study is that the examination of the impact of tax literacy on tax-deferred and the usual savings account choices fulfills a gap in tax allocation literature to attain tax-efficient retirement savings. We find that those with high tax literacy are more likely to have personal investments with tax breaks, such as the individual-type Defined Contribution pension plan (iDeCo) and Nippon Individual Savings Account (NISA). We also confirm our finding with the web experiment result that tax benefit information is more effective in improving willingness to have iDeCo for those who have high tax literacy. Our findings have an important policy implication in that expanding the tax benefit would encourage people to start having personal investments, and that it is crucial to invest in tax literacy education to improve people’s understanding of tax benefits and to get the tax benefits of personal investments across people.

The rest of the paper is organized as follows: Section II discusses the data and key variables. Section III lays out our research strategy to examine the effect of the level of tax literacy on the probability of having different types of investments. Section IV presents the empirical results. Finally, Section V concludes our findings.

II. Data and Key Variables

We use an original web survey data collected in March 2018 of 20 to 69-year-old Japanese residents who are monitor members of an internet research company called MyVoice Communications Inc. The responses are gathered to represent the Japanese population distribution of age, sex, and living area, and the survey resulted in 1,000 responses.

The questions in the survey include ownership of different types of personal investments, such as iDeCo, NISA, personal pension insurance and an individual brokerage account. Out of these four types of investments, iDeCo, NISA and personal pension insurance have tax advantages in contributions and/or profits, while an individual brokerage account does not.

iDeCo is a pension investment program similar to the traditional individual retirement account (IRA) established in the United States, which started in 2001 in Japan. iDeCo has a tax advantage on both contribution and profit. In other words, all the contributions below the limit are tax-deductible while profits are non-taxable. The government has been expanding the program in terms of eligibility and contribution limit. Up until 2016, iDeCo was available to only those who were self-employed or those who were company employees but did not have company-based corporate pension plans. However, after the policy reform, it has been available to almost all people under 60 years old since 2017. The contribution limit has been elevated as well; it was 15,000 JPY per month in 2001 but 23,000 JPY per month after 2010 for company employees.[1]

NISA is similar to the individual savings accounts (ISA) in the United Kingdom, which started in 2014 in Japan. It has a tax advantage on profit. In other words, profits are non-taxable. It has been expanding in terms of contribution limit and investment types. The contribution limit has elevated in 2016 from 1 million JPY per year to 1.2 million JPY per year. Furthermore, a new type of NISA for long-term investments called *tsumitate* NISA started in 2018.

Personal pension insurance provided by life insurance companies also has tax advantages. It has a tax advantage on premiums where the premiums under the tax-exemption limit are tax-deductible. The tax advantage was introduced in 1984, and the tax-exemption limit was 5,000 JPY per year when it was introduced. Currently, it is 40,000 JPY per year.

To measure tax literacy, we used six questions as shown in Table 1; questions 1 and 2 regard the ability to understand the tax benefit following Clark et al. (2014), and questions 3 to 6 regard the knowledge of tax benefit. As to the measurement of financial literacy, in addition to three questions about compound interest effect, bond price and diversified investment used in previous studies (Lusardi and Mitchell 2011; Sekita 2011), we also include a question about foreign exchange since foreign investment is one of the most important aspects for long-term diversified investments in Japan.

[Insert Table 1 and Table 2 here]

The simplest way to construct the tax/financial literacy variable is to use the number of correct answers for each literacy question. However, since this approach has the drawback of weighting each question equally regardless of its difficulty, we construct the tax literacy and financial literacy score using a weighted scoring called PRIDIT following Behrman et al. (2010) and Sekita (2013).[2]

We also conduct a simple experiment at the end of the web survey. First, we show an image including tax advantage information of iDeCo, NISA, *tsumitate* NISA and personal pension insurance to half of the randomly chosen respondents (treatment group). The image we use for the experiment is available as Figure A1 in the online appendix. Second, we ask willingness to have different types of

[1] There are different contribution limits depending on their working style and the employer's pension system.
[2] See Brockett et al. (2002), Lieberthal (2008), and Sekita (2013) for how to calculate the PRIDIT score.

investments (iDeCo, NISA, *tsumitate* NISA, personal pension insurance and an individual brokerage account) for every participant, irrespective of being in the treatment group or not. With this experiment, we check the impact of tax advantage information on individual attitude towards different types of investments.

III. The Empirical Model

First, to test if tax literacy increases the probability of having different types of investments, we estimate the following linear probability model:

$$(1) \qquad Y_i = \beta_0 + \beta_1 \, tax_i + \beta_2 \, fin_i + \boldsymbol{X}_i \gamma + \varepsilon$$

where Y_i is a dummy variable taking 1 if they have different types of investments and 0 if otherwise. Here, different types of investments include iDeCo, NISA (including *tsumitate* NISA), personal pension insurance and individual brokerage accounts[3]. *tax* indicates the tax literacy score and *fin* indicates the financial literacy score. $\boldsymbol{X}$ is a set of control variables including age, female dummy, income, financial asset, dummy for university graduates, and time and risk preference variables.[4] ε is an error term. Note that those who currently have defined-contribution type corporate pension plans are dropped from the sample when regressing the dummy for having iDeCo, since there are limitations in having iDeCo for them. Moreover, those who have had defined-contribution type corporate pension plans are dropped as well since those people automatically receive iDeCo accounts after leaving the company.

Second, since the endogeneity of tax literacy and financial literacy are suspect, we conduct the two-stage least squares (TSLS) estimation. Here, we employ three instrumental variables for the endogenous variables of tax and financial literacy: *language*, *math*, and *numeracy*. The *language* variable is constructed using the question below following Sekita (2011):

> When you were 15 years old, where did your grades in Japanese language rank among others in your grade? (1) In lower rank; (2) in rather lower rank; (3) in the middle; (4) in rather higher rank; and (5) in higher rank.

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[3] Many of those who had individual brokerage accounts made account of NISA when it was introduced in 2014. Since the purpose of our study is to estimate the impact of tax literacy on an individual brokerage account and compare it with other options with tax advantages, only those who do not have NISA/*tsumitate* NISA but an individual brokerage account take 1 for the individual brokerage account variable.

[4] Descriptive statistics of all the variables used for the analysis are presented in Table A1 in the online appendix. In addition, the detailed questions we used to measure time preference based on Meier and Sprenger (2009) and risk preference based on Holt and Raury (2002) are explained in section 3 in the online appendix.

We construct a continuous variable taking 1 if one chooses "in lower rank" and 5 if one chooses "in higher rank." The *math* variable is constructed using the following question in the same way as the *language* variable:

> When you were 15 years old, where did your grades in math rank among others in your grade? (1) In lower rank; (2) in rather lower rank; (3) in the middle; (4) in rather higher rank; and (5) in higher rank

Since we include the dummy for missing data, *language* and *math* include missing data, replaced by 0. As to *numeracy* measurement, we use four questions following Ikawa and Kusumi (2018) and construct the PRIDIT score in the same way as we construct the tax/financial literacy score.[5]

Furthermore, we investigate whether exposure to tax advantage information motivates people to have investment options. To formulate an empirical model, we define a treatment variable *T*, a dummy variable taking 1 if they are in the treatment group (provided the tax benefit information in the experiment). We set up a standard analysis of covariance (ANCOVA) model to estimate the treatment effect:

(2) $Y^{w}_{i} = \beta_0 + \delta T_i + \varepsilon$

where Y^w is a dummy variable taking 1 if one is willing to have different types of investment options. In the same way as *Y*, different types of investments include iDeCo, NISA, personal pension insurance and individual brokerage accounts. The treatment effects can be captured by the estimated parameter, δ, provided that *T* is orthogonal to the error term.[6] In addition to Equation (2), we also accommodate heterogeneous treatment effects by allowing for treatment effect δ to be specific to the level of tax literacy. The following equation represents this augmented empirical model:

(3) $Y^{w}_{i} = \beta_0 + \beta_1 \, tax_i + \beta_2 \, fin_i + \delta T_i + \delta^{t} T_i \times tax_i + \boldsymbol{X_i}\gamma + \varepsilon$

[5] The four questions used to measure numeracy are as follows (the percentage of correct answers in parentheses): 1. Suppose you throw an undistorted pentahedron dice for 50 times. How many times do you get odd numbers on average? (62.2%). 2. There are 1,000 residents in a small town. Out of 1,000, 500 are in a chorus club. Out of the 500 chorus members, 100 are male. What is the probability that a person belongs to a chorus club when we pick one male resident randomly in the town? (36.8%) 3. Suppose you throw a hexahedron dice. But this dice is fixed to have 2 times more possibility of having a 6 compared to the probability of each of other numbers. After throwing the dice 70 times, how many 6s do you get on average? (39.7%) 4. Among the mushrooms you get in a forest, 20% is red, 50% is brown, and 30% is white. 20% of the red mushroom are poisoned. 5% of non-red mushrooms are poisoned. What is the probability that a poisoned mushroom is red? (21.1%)

[6] We conduct a balancing test and confirm that the treatment is provided randomly (See Table A4 in the online appendix for the balancing test results).

where δ^t comprises the heterogeneous treatment effects, depending on the level of tax literacy. If $\delta^t > 0$, tax literacy boosts the impact of the treatment. Other characters of tax_i, fin_i, $\boldsymbol{X}_i$ and ε follow the explanation of Equation (1). Here, since the endogeneity of *tax* and *fin* are suspect, we conduct TSLS estimation. *tax* and *fin* are instrumented by *lang*uage, *math*, *numeracy*, dummy variable for missing data of *language*, dummy variable for missing data of *math* and the set of control variables. Since we include the dummy for missing data, *language* and *math* include missing data, replaced by 0. Furthermore, since we include $tax \times T$ in the model, we also include the interaction term ($tax \times T$) in the endogenous variables and all the interactions between T and the instrument variables are added to the instrument variables.

IV. Empirical Results

Since the purpose of our study is to test the impact of tax literacy on the probability of having different types of investments, in our survey with 1,000 observations, we use 719 observations who are involved in their own savings or investment decision-making. We use the survey question asking, "Who makes your savings/investment decision?" to separate those who are involved in their own savings/investment decision-making. We include only those who answer "by myself," "together with spouse" or "together with family members," but exclude those who answer "spouse" or "parent." In addition, as explained earlier, we use 623 observations who are not only involved in their own savings/investment decision-making, but are also eligible to have iDeCo for estimation related to iDeCo possession.

Columns (1) to (4) of Table 3 present the ordinary least squares (OLS) estimation and columns (5) to (8) of Table 3 present the TSLS estimation results of Equation 1. Both OLS and TSLS estimation results show that the tax literacy variable is positive and statistically significant for iDeCo and NISA possession while it is not statistically significant for individual brokerage account possession. On the other hand, consistent with literature, the financial literacy variable is positive and statistically significant to the probability of having individual brokerage accounts without tax benefits. The first stage estimation results are shown in Table A5 in the online appendix. In addition, weak identification test and over-identification test results support the validation of the model.

[Insert Table 3 here]

As for the estimation results of Equation 2, column (1) in Table 4 shows that treatment is positive and statistically significant. Table 4 only shows the regression of willingness to have iDeCo but not other types of investments since no significant treatment effects were observed on other investments, probably because iDeCo has the largest tax benefit. Furthermore, columns (2) and (3) of Table 4 present the estimation results of Equation 3 without and with controls, respectively. They indicate that the interaction term of *tax* and T is positive and statistically significant, which suggests that tax literacy boosts the impact of the treatment effects. The first stage estimations are presented in Table A6 of the online appendix and the weak identification test and over-identification test results also support the validation of the model.

[Insert Table 4 here]

V. Concluding Remarks

Though the Japanese government has provided various tax advantages for the purpose of encouraging individuals to have personal pension investments, a correct understanding of tax advantages among people is necessary to achieve their intended goal. Previous studies show that financial literacy plays an important role in the decision of having different types of investments, but there have never been any studies focusing on the impact of tax literacy separately from financial literacy. Furthermore, though there are some studies indicating people make reasonable decisions in asset location under taxation, the mechanisms behind their decisions have not been well investigated. Hence, to provide new insights in the field of financial literacy and asset location together with retirement saving planning, we investigate the impact of tax literacy on having different types of investments with tax advantages.

Using our unique data, we find that improving tax literacy is the key to increase the participation ratio of personal investment programs with tax benefits. While our study does not indicate the significance of financial literacy in improving the probability of having investments with tax benefits, our study does not contradict previous studies indicating the importance of financial literacy in investment decisions because our results also show the significance of financial literacy in improving the probability of having an individual brokerage account without tax benefits. However, we add inputs to the literature that tax literacy is the key for investments with tax benefits and it can be the driving factor to achieve reasonable asset location under taxation.

Our results provide a certain policy implication. While our results show that tax literacy is the key to increase the probability of having investments with tax advantages, the average level of tax literacy is not high. For example, not many people can correctly understand how much benefit they can get from those advantages, as only about 30 percent of the people calculate tax benefits correctly in our survey. Furthermore, not many people know tax advantages for post-retirement investments, as only 16 percent of the people know the tax benefit of iDeCo. Therefore, expanding tax benefits to post-retirement investments might not be an effective way to increase participation rate, but investing in tax literacy education and getting tax benefits of personal pension investments across people would be important for improving participation in personal retirement investments with tax benefits.

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Table 1. Question and answer distribution for the tax literacy measure

(Correct choice underlined)

1. Suppose income tax is 20 %. How much does your income tax decrease when you put 100,000 JPY to a special account in which all the contributions get a tax exemption, in comparison to putting the same amount of money in an ordinary savings account with the same interest rate?	Answer distribution
(1) Decreases 100,000 JPY	3.1 %
(2) Decreases 80,000 JPY	4.3%
<u>(3) Decreases 20,000 JPY</u>	<u>35.2%</u>
(4) Does not decrease at all	12.9%
(5) Don't know	44.5%
2. Suppose income tax is 20 % and you buy a 100,000 JPY financial plan, in which all the contributions get a full tax exemption. How much is your net expenditure for the financial plan after considering the tax benefit?	Answer distribution
(1) 100,000 JPY	9.6%
<u>(2) 80,000 JPY</u>	<u>28.5%</u>
(3) 20,000 JPY	10.0%
(4) Does not change at all	4.1%
(5) Don't know	47.8%
3. Which of the following are correct about the tax advantages of iDeCo?	Answer distribution
(1) It has a tax benefit only for contributions.	3.5%
(2) It has a tax benefit only for profits.	3.8%
<u>(3) It has a tax benefit for both contributions and profits.</u>	<u>15.6%</u>
(4) It does not have a tax benefit.	7.3%
(5) Don't know	69.8%
4. Which of the following are correct about the tax advantages of NISA?	Answer distribution
(1) It has a tax benefit only for contributions.	2.9%
<u>(2) It has a tax benefit only for profits.</u>	<u>14.9%</u>
(3) It has a tax benefit for both contributions and profits.	12.5%
(4) It does not have a tax benefit.	7.6%
(5) Don't know	62.1%
5. Which of the following are correct about the tax advantages of *Tsumitate* NISA?	Answer distribution
(1) It has a tax benefit only for contributions.	2.3%
<u>(2) It has a tax benefit only for profits.</u>	<u>12.0%</u>
(3) It has a tax benefit for both contributions and profits.	12.7%
(4) It does not have a tax benefit.	7.4%
(5) Don't know	65.6%
6. Which of the following are correct about the tax advantages of personal pension insurance?	Answer distribution
<u>(1) It has a tax benefit only for contributions.</u>	<u>9.8%</u>
(2) It has a tax benefit only for profits.	3.8%
(3) It has a tax benefit for both contributions and profits.	9.2%
(4) It does not have a tax benefit.	10.4%
(5) Don't know	66.8%

Table 2. Question and answer distribution of the financial literacy measure
(Correct choice underlined)

1. Suppose you had 1 million yen in a savings account and the interest rate was 5% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?	Answer distribution
<u>(1) More than 1.05 million JPY</u>	<u>59.0 %</u>
(2) 1.05 million JPY	12.4%
(3) Less than 1.05 million JPY	11.4%
(4) Don't know	17.2%
2. Suppose the current interest rate is 1 percent. What happens to the value of 10-year fixed-rate government bonds with a 1 percent interest rate if the interest rate rose to 3 percent in the future?	Answer distribution
(1) Value increases	15.7%
(2) Value does not change	18.2%
<u>(3) Value decreases</u>	<u>27.2%</u>
(4) Don't know	38.9%
3. Assume you have 1,000 USD in your foreign currency account in Japan. What happens to the value of this saving when the JPY depreciates toward the USD?	Answer distribution
<u>(1) Value increases</u>	<u>46.1%</u>
(2) Value does not change	5.8%
(3) Value decreases	24.2%
(4) Don't know	23.9%
4. Which is a less risky asset in terms of volatility: the stock of one company or an index fund reflecting the Nikkei Stock Average (mutual fund)?	Answer distribution
(1) One company	4.8%
(2) No difference	16.0%
<u>(3) The Nikkei Stock Average (mutual fund)</u>	<u>36.4%</u>
(4) Don't know	47.6%

Table 3. OLS and TSLS estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model:	OLS	OLS	OLS	OLS	IV	IV	IV	IV
Dependent variable:	iDeCo	NISA	Personal pension insurance	Individual brokerage account	iDeCo	NISA	Personal pension insurance	Individual brokerage account
tax (tax literacy)	0.0876	0.232	0.131	0.0196	0.241	0.496	0.108	-0.214
	(0.0326)	(0.0307)	(0.0310)	(0.0285)	(0.1450)	(0.2650)	(0.3220)	(0.2800)
fin (financial literacy)	-0.0177	0.0687	-0.0283	0.108	-0.168	-0.152	0.208	0.313
	(0.0182)	(0.0278)	(0.0266)	(0.0302)	(0.1140)	(0.1630)	(0.2390)	(0.1880)
Time discount rate	0.0123	0.0033	0.0028	0.0005	0.008	-0.0049	0.0185	0.00835
	(0.0062)	(0.0083)	(0.0095)	(0.0063)	(0.0073)	(0.0116)	(0.0135)	(0.0107)
Present bias dummy	0.0017	-0.0133	-0.0299	-0.0393	0.0043	-0.0106	-0.0013	-0.0405
	(0.0251)	(0.0398)	(0.0364)	(0.0319)	(0.0282)	(0.0444)	(0.0435)	(0.0348)
Risk preference	-0.0008	-0.0011	0.0048	0.0013	-0.0009	-0.0036	0.0045	0.00357
	(0.0029)	(0.0052)	(0.0051)	(0.0043)	(0.0031)	(0.0064)	(0.0058)	(0.0052)
Age	0.0019	-0.0087	0.0051	0.0067	0.001	-0.0105	0.0061	0.00827
	(0.0046)	(0.0090)	(0.0085)	(0.0091)	(0.0057)	(0.0098)	(0.0093)	(0.0103)
Female dummy	0.0281	0.0653	0.0453	-0.038	0.0002	0.0274	0.129	-0.00119
	(0.0256)	(0.0513)	(0.0508)	(0.0517)	(0.0290)	(0.0650)	(0.0754)	(0.0531)
Financial asset	-0.000002	0.00004	0.0001	0.0001	-0.00001	0.00004	0.00005	0.00013
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Income	0.0002	0.0001	0.0002	-0.00002	0.0002	0.0001	0.0003	-0.00003
	0.0000	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)
University graduates dummy	-0.058	0.0054	-0.0105	-0.0403	-0.0524	0.00126	-0.0401	-0.0377
	(0.0215)	(0.0417)	(0.0406)	(0.0429)	(0.0241)	(0.0425)	(0.0473)	(0.0466)
Age squared	-0.00003	0.00009	-0.00002	-0.0001	-0.00001	0.00012	-0.00005	-0.0001
	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
N	623	719	719	719	623	719	719	719
adj. R-sq	0.054	0.183	0.066	0.077	-0.103	0.029	-0.043	-0.094
Weak IV test: KPW F stat					35.03	38.82	47.50	38.82
(maximal IV relative bias)					(<5%)	(<5%)	(<5%)	(<5%)
Hansen J stat					1.29	1.50	4.13	3.24
(p-value)					(0.73)	(0.68)	(0.13)	(0.36)

Notes: The dependent variable is *Y* (dummy variable taking 1 if one has iDeCo/NISA/personal pension insurance/ general brokerage account). Cluster robust standard errors (clustered by 60 categories used to gather sample to match population distribution of Japan according to age, sex and living area) are in parenthesis. The constant term is not presented, but available from the corresponding author upon request. Columns (1) to (4) present OLS estimation results and columns (5) to (8) present the second stage estimation results of two-stage least squares regression. Here, *tax* and *fin* are instrumented by *lang*uage, *math*, *numeracy*, dummy variable for missing data of *language*, dummy variable for missing data of *math* and the set of control variables for column (5), (6) and (8). For column (7), *tax* and *fin* are instrumented by *lang*uage and *math*, dummy variable for missing data of *language*, dummy variable for missing data of *math* and the set of control variables. Since we include the dummy for missing data, *language* and *math* include missing data, replaced by 0. KPW F stat represents the Kleibergen-Paap rk Wald F statistic.

Table 4. Estimation of the treatment effect

	(1)	(2)	(3)
Model:	OLS	IV	IV
T (treatment)	0.0688	0.0513	0.0446
	(0.0335)	(0.0355)	(0.0356)
tax (tax literacy)		-0.000337	0.100
		(0.359)	(0.304)
tax × *T*		0.300	0.268
		(0.178)	(0.184)
fin (financial literacy)		-0.0746	-0.0460
		(0.200)	(0.175)
Time discount rate			0.0181
			(0.0115)
Present bias dummy			0.0142
			(0.0443)
Risk preference			0.00327
			(0.00661)
Age			-0.000119
			(0.0108)
Female dummy			0.0643
			(0.0694)
Financial asset			-0.0000116
			(0.0000849)
Income			0.000398
			(0.000164)
University graduates dummy			-0.0922
			(0.0436)
Age squared			-0.0000826
			(0.000114)
N	623	623	623
adj. R-sq	0.005	-0.005	0.078
KPW F stat		58.73	19.49
(max IV relative bias)		(<5%)	(<5%)
Hansen J stat		4.343	5.021
(p-value)		(0.63)	(0.54)

Notes: The dependent variable is Y^w (dummy variable taking 1 if they wish to have iDeCo). Cluster robust standard errors (clustered by 60 categories used to gather sample to match population distribution of Japan according to age, sex and living area) are in parenthesis. The constant term is not presented, but available from the corresponding author upon request. Columns (1) present OLS estimation result and columns (2) and (3) present the second stage estimation results of two-stage least squares regression. Here, *tax* and *fin* are instrumented by *lang*uage, *math*, *numeracy*, dummy variable for missing data of *language*, dummy variable for missing data of *math* and the set of control variables. Since we include the dummy for missing data, *language* and *math* includes missing data, replaced by 0. Furthermore, since we include *tax* × *T* in the model, we also include the interaction term (*tax* × *T*) in the endogenous variables and all the interactions between *T* and the instrument variables are added to the instrument variables. KPW F stat represents the Kleibergen-Paap rk Wald F statistic.

Online Appendix

Tax Literacy and Personal Investments for Post-Retirement Years

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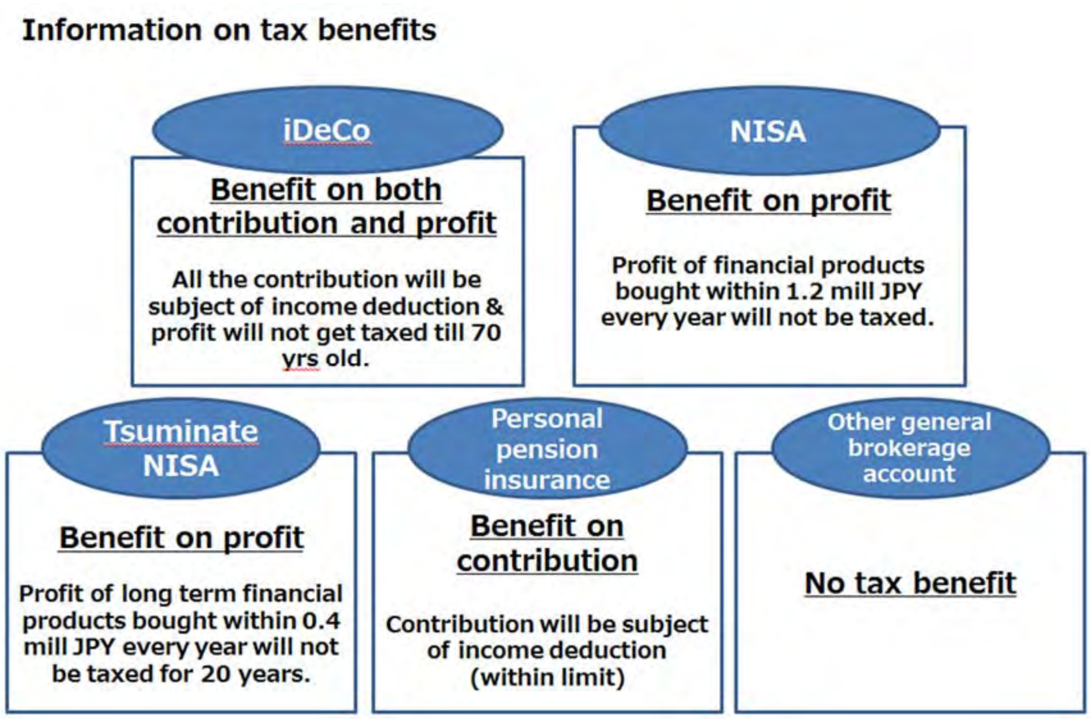
1. Image used for the experiment to provide tax benefit information (English translation)

Figure A1. Image used for the experiment



2. Descriptive statistics

Table A1. Descriptive statistics

	Observation	Mean	Std.Dev	Min	Max
Y (iDeCo)	1000	0.071	0.257	0	1
Y (NISA)	1000	0.205	0.404	0	1
Y (personal pension insurance)	1000	0.215	0.411	0	1
Y (individual brokerage account)	1000	0.144	0.351	0	1
tax (tax literacy)	1000	0.000	0.641	-0.457	1.944
fin (financial literacy)	1000	0.023	0.686	-0.824	1.173
language: 0. Cannot answer	1000	0.017	0.129	0	1
language: 1. In lower rank	1000	0.052	0.222	0	1
language: 2. In rather lower rank	1000	0.083	0.276	0	1
language: 3. In the middle	1000	0.299	0.458	0	1
language: 4. In rather higher rank	1000	0.247	0.431	0	1
language: 5. In higher rank	1000	0.302	0.459	0	1
math: 0. Cannot answer	1000	0.017	0.129	0	1
math: 1. In lower rank	1000	0.088	0.283	0	1
math: 2. In rather lower rank	1000	0.134	0.341	0	1
math: 3. In the middle	1000	0.252	0.434	0	1
math: 4. In rather higher rank	1000	0.198	0.399	0	1
math: 5. In higher rank	1000	0.311	0.463	0	1
numeracy	1000	0.000	0.692	-0.803	1.196
Time discount rate	1000	1.880	1.670	0	7
Present bias dummy	1000	0.189	0.392	0	1
Risk preference	1000	3.899	2.849	0	10
Age	1000	46.171	13.433	20	69
Female dummy	1000	0.501	0.500	0	1
Financial asset	1000	742.72	366.79	0	1857.27
Income	1000	265.45	196.93	0	753.77
University graduates dummy	1000	0.503	0.500	0	1
T (treatment)	1000	0.487	0.500	0	1
Y^w (iDeCo)	1000	0.261	0.439	0	1
Y^w (NISA)	1000	0.317	0.466	0	1
Y^w (personal pension insurance)	1000	0.281	0.450	0	1
Y^w (individual brokerage account)	1000	0.247	0.431	0	1

Notes: Unit of financial asset and income is 10,000 JPY. These variables are treated as continuous variables, but they were originally structured as ordered categories. However, to better understand the estimation results, we constructed a continuous variable using interval regression. For the estimation, in addition to the category number of financial asset and income, female dummy, age, age squared, prefecture dummies and university graduates dummy were employed. Estimation results of interval regression are not reported here but are available upon request.

3. Measurement of time and risk preference

We made a time discount variable by using the traditional multiple price list shown in Table A2. Following Meier and Sprenger (2009), we construct the time discount rate variable as the average sum of choosing choice A among questions 1 to 7 and the sum of choosing choice A among questions 8 to 14. Also, we made a dummy variable for present-bias taking 1 for those whose time discount rate calculated by questions 1 to 7 is higher than that of questions 8 to 14.

Table A2. Multiple price list used to capture time preference

	A		B	
1	Receive 8,000 JPY	today	Receive 8,000 JPY	1 month later
2	Receive 7,500 JPY	today	Receive 8,000 JPY	1 month later
3	Receive 7,000 JPY	today	Receive 8,000 JPY	1 month later
4	Receive 6,500 JPY	today	Receive 8,000 JPY	1 month later
5	Receive 6,000 JPY	today	Receive 8,000 JPY	1 month later
6	Receive 5,000 JPY	today	Receive 8,000 JPY	1 month later
7	Receive 4,000 JPY	today	Receive 8,000 JPY	1 month later
	A		B	
8	Receive 8,000 JPY	6 month later	Receive 8,000 JPY	7 month later
9	Receive 100,000 JPY	7 days later	Receive 8,000 JPY	7 month later
10	Receive 100,000 JPY	7 days later	Receive 8,000 JPY	7 month later
11	Receive 100,000 JPY	7 days later	Receive 8,000 JPY	7 month later
12	Receive 100,000 JPY	7 days later	Receive 8,000 JPY	7 month later
13	Receive 100,000 JPY	7 days later	Receive 8,000 JPY	7 month later
14	Receive 100,000 JPY	7 days later	Receive 8,000 JPY	7 month later

We made a risk preference parameter following Holt and Raury (2002), using the ten paired lottery-choice decisions shown in Table A3. We use the sum of selecting choice B as the risk preference variable.

Table A3. The ten paired lottery-choice decisions

	A	B
1	10 % 200 JPY; 90% 160 JPY	10 % 358 JPY; 90% 10 JPY
2	20 % 200 JPY; 80% 160 JPY	10 % 358 JPY; 90% 10 JPY
3	30 % 200 JPY; 70% 160 JPY	10 % 358 JPY; 90% 10 JPY
4	40 % 200 JPY; 60% 160 JPY	10 % 358 JPY; 90% 10 JPY
5	50 % 200 JPY; 50% 160 JPY	10 % 358 JPY; 90% 10 JPY
6	60 % 200 JPY; 40% 160 JPY	10 % 358 JPY; 90% 10 JPY
7	70 % 200 JPY; 30% 160 JPY	10 % 358 JPY; 90% 10 JPY
8	80 % 200 JPY; 20% 160 JPY	10 % 358 JPY; 90% 10 JPY
9	90 % 200 JPY; 10% 160 JPY	10 % 358 JPY; 90% 10 JPY
10	100 % 200 JPY; 0% 160 JPY	10 % 358 JPY; 90% 10 JPY

4. Balancing test

Table A4. Balancing test results

Dependent variable:	(1) *T* (treatment)
tax (tax literacy)	0.0174
	(0.0316)
fin(financial literacy)	0.00497
	(0.0285)
Time discount rate	-0.00256
	(0.00978)
Present bias dummy	-0.0289
	(0.0503)
Risk preference	-0.000234
	(0.00535)
Age	0.0109
	(0.00804)
Female dummy	-0.0331
	(0.0531)
Financial asset	-0.000136
	(0.0000753)
Income	-0.0000615
	(0.000163)
University graduates dummy	0.0739
	(0.0411)
Age squared	-0.0000990
	(0.0000875)
N	1000
adj. R-sq	-0.004
F stat	0.59
Prob > F	0.83

Notes: The dependent variable is *T* (dummy variable taking 1 if one is in the treatment group). Cluster robust standard errors (clustered by 60 categories used to gather sample to match population distribution of Japan according to age, sex and living area) are in parentheses. The constant term is not presented.

5. First stage estimation results

Table A5. First stage estimation results of Table 3

	(1)	(2)	(3)	(4)	(5)	(6)
	tax	*fin*	*tax*	*fin*	*tax*	*fin*
language	-0.0262	0.00938	-0.0293	0.0106	-0.0227	0.0213
	(0.0282)	(0.0299)	(0.0251)	(0.0265)	(0.0257)	(0.0267)
Missing dummy for	-0.319**	0.979***	-0.442***	0.967***	-0.533***	0.820***
language	(0.139)	(0.132)	(0.122)	(0.118)	(0.121)	(0.117)
math	0.0685	0.0453	0.0643	0.0590	0.0878	0.0970
	(0.0311)	(0.0229)	(0.0295)	(0.0235)	(0.0295)	(0.0239)
Missing dummy for	0.992***	-0.0736	1.072***	-0.0263	1.306***	0.351+
math	(0.166)	(0.190)	(0.155)	(0.163)	(0.154)	(0.232)
numeracy	0.173	0.283	0.176	0.284	-	-
	(0.0445)	(0.0333)	(0.0417)	(0.0325)	-	-
Time discount rate	-0.0223	-0.0433	-0.0142	-0.0466	-0.0257	-0.0652
	(0.0154)	(0.0170)	(0.0141)	(0.0155)	(0.0149)	(0.0160)
Present bias dummy	-0.0886	-0.0635	-0.0845	-0.0833	-0.101	-0.110
	(0.0661)	(0.0651)	(0.0673)	(0.0571)	(0.0679)	(0.0588)
Risk preference	-0.00403	-0.00658	0.00546	-0.00657	0.00785	-0.00272
	(0.00908)	(0.00962)	(0.00767)	(0.00850)	(0.00783)	(0.00952)
Age	-0.00181	-0.0108	0.00347	-0.00496	0.00572	-0.00133
	(0.0162)	(0.0134)	(0.0170)	(0.0128)	(0.0168)	(0.0134)
Female dummy	-0.106	-0.295	-0.0970	-0.302	-0.148	-0.385
	(0.117)	(0.0792)	(0.128)	(0.0831)	(0.128)	(0.0830)
Financial asset	0.000173	0.000140	0.000125	0.000161	0.000161	0.000220
	(0.00014)	(0.00011)	(0.00014)	(0.000108)	(0.00014)	(0.000110)
Income	-0.000017	-0.00002	0.000020	-0.0000081	-0.000033	-0.000093
	(0.00031)	(0.00026)	(0.00032)	(0.000259)	(0.00031)	(0.000250)
University graduates dummy	-0.00977	-0.00504	0.0482	0.00716	0.0748	0.0500
	(0.0863)	(0.0679)	(0.0836)	(0.0650)	(0.0820)	(0.0635)
Age squared	-8.49e-08	0.000164	-0.00005	0.0000965	-0.00007	0.0000607
	(0.00017)	(0.00014)	(0.00018)	(0.000136)	(0.00018)	(0.00014)
N	623	623	719	719	719	719
SW F stat	49.64	43.84	57.34	51.68	67.82	56.79

Notes: Columns (1) and (2) present the first stage estimation of column (5) in Table 3. Columns (3) and (4) present the first stage estimation result of columns (6) and (8) in Table 3. Columns (5) and (6) present the first stage estimation result of column (7) in Table 3. Cluster robust standard errors (clustered by 60 categories used to gather samples to match the population distribution of Japan according to age, sex and living area) are in parentheses. The constant term is not presented but available from the corresponding author upon request. Since we include the dummy for missing data, *language* and *math* include missing data, replaced by 0. SW F stat represents the Sanderson-Windmeijer first-stage chi-squared and F statistics.

Table A6. First stage estimation results of Table 4

	(1)	(2)	(3)	(4)	(5)	(6)
	fin	*tax*	*T* × *tax*	*fin*	*tax*	*T* × *tax*
language	-0.00624	0.0200	-9.12e-17	0.00222	0.0209	-0.000751
	(0.0397)	(0.0280)	(.)	(0.0397)	(0.0300)	(0.00573)
Missing dummy for *language*	0.908***	-0.251**	-4.21e-16	0.939***	-0.211	0.0597
	(0.135)	(0.109)	(.)	(0.173)	(0.170)	(0.0748)
math	0.0393	0.0531	1.40e-16	0.0256	0.0478	0.00370
	(0.0309)	(0.0328)	(.)	(0.0289)	(0.0332)	(0.00755)
Missing dummy for *math*	-0.113	1.182***	6.53e-16	0.0290	1.165***	-0.0357
	(0.115)	(0.155)	(.)	(0.156)	(0.178)	(0.0734)
numeracy	0.375	0.142	2.12e-17	0.290	0.0986	-0.0205
	(0.0470)	(0.0721)	(.)	(0.0425)	(0.0719)	(0.0130)
T	-0.251	0.206	-0.0453	-0.257	0.207	-0.0371
	(0.199)	(0.202)	(.)	(0.184)	(0.203)	(0.178)
language × *T*	0.00399	-0.0846	-0.0646	0.0247	-0.0809	-0.0634
	(0.0563)	(0.0511)	(.)	(0.0543)	(0.0504)	(0.0451)
math × *T*	0.0580	0.0350	0.0881	0.0415	0.0324	0.0837
	(0.0428)	(0.0568)	(.)	(0.0444)	(0.0564)	(0.0506)
numeracy × *T*	-0.0166	0.143	0.285	-0.0114	0.145	0.289
	(0.0698)	(0.0906)	(.)	(0.0724)	(0.0942)	(0.0553)
Time discount rate				-0.0422	-0.0230	-0.0179
				(0.0169)	(0.0158)	(0.00976)
Present bias dummy				-0.0627	-0.0852	-0.0808
				(0.0649)	(0.0677)	(0.0442)
Risk preference				-0.00650	-0.00422	-0.00129
				(0.00960)	(0.00894)	(0.00627)
Age				-0.00979	-0.00128	-0.00441
				(0.0135)	(0.0164)	(0.0119)
Female dummy				-0.305	-0.0992	-0.0580
				(0.0768)	(0.115)	(0.0785)
Financial asset				0.000140	0.000178	0.0000616
				(0.000116)	(0.000137)	(0.0000820)
Income				-0.0000424	0.00000220	-0.0000190
				(0.000258)	(0.000311)	(0.000202)
University graduates dummy				-0.00617	-0.0150	-0.00296
				(0.0679)	(0.0856)	(0.0524)
Age squared				0.000154	-0.00000659	0.00000303
				(0.000145)	(0.000174)	(0.000124)
N	623	623	623	623	623	623
SW F stat	9.20E+15	3.90E+15	-	33.51	51.01	84.41

Notes: Columns (1) to (3) present the first stage estimation of column (2) in Table 4. Columns (4) and (6) present the first stage estimation result of column (3) in Table 4. Cluster robust standard errors (clustered by 60 categories used to gather samples to match the population distribution of Japan according to age, sex and living area) are in parentheses. The constant term is not presented but available from the corresponding author upon request. Since we include the dummy for missing data, *language* and *math* include missing data, replaced by 0. SW F stat represents the Sanderson-Windmeijer first-stage chi-squared and F statistics.